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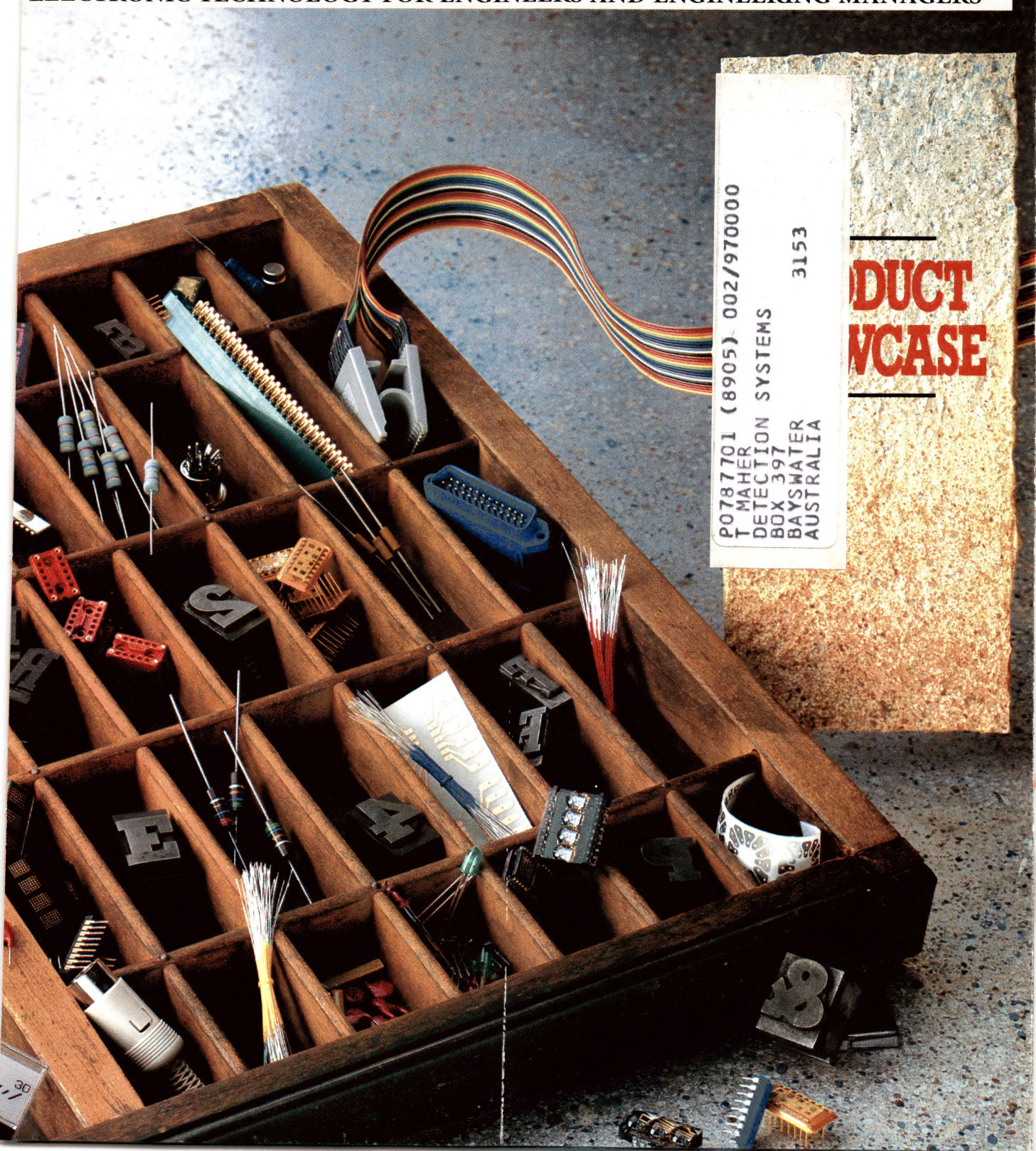
EDN®

SPECIAL ISSUE—Part 2
Product Showcase No 27

Highlighting key trends in components, instruments, computers & peripherals, and computer-aided engineering

Expanded literature section

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS



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Devices' 29K. platform.

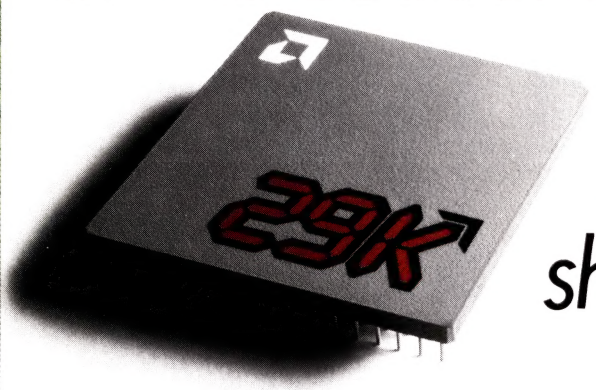


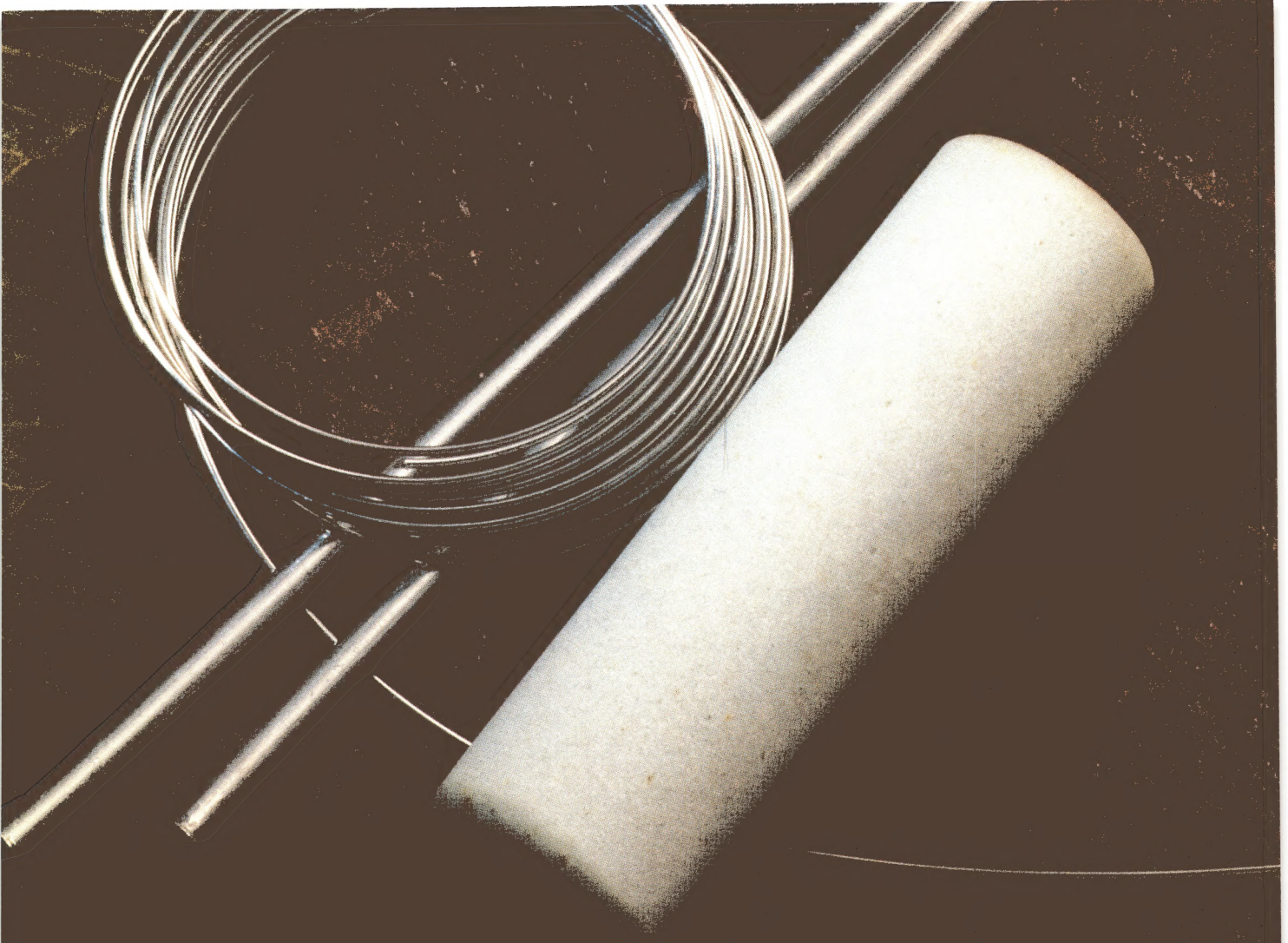
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CIRCLE NO 2

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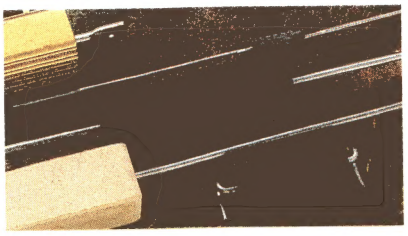
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absorptive... reflective



dc to 4.6 GHz from $32.95 (1-24)

Tough enough to pass stringent MIL-STD-883 tests, useable from dc to 6GHz and smaller than most RF switches, Mini-Circuits' hermetically-sealed (reflective) KSW-2-46 and (absorptive) KSWA-2-46 offer a new, unexplored horizon of applications. Unlike pin diode switches that become ineffective below 1MHz, these GaAs switches can operate down to dc with control voltage as low as -5V, at a blinding 2ns switching speed.

Despite its extremely tiny size, only 0.185 by 0.185 by 0.06 in., these switches provide 50dB isolation (considerably higher than many larger units) and insertion loss of only 1dB. The absorptive model KSWA-2-46 exhibits a typical VSWR of 1.5 in its "OFF" state over the entire frequency range. These surface-mount units can be soldered to pc boards using conventional assembly techniques. The KSW-2-46, priced at only $32.95, and the KSWA-2-46, at $48.95, are the latest examples of components from Mini-Circuits with unbeatable price/performance.

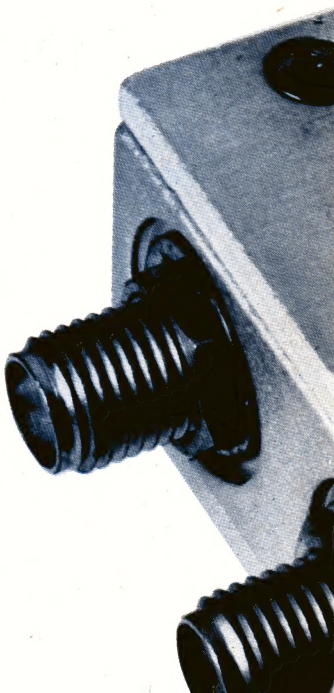
Connector versions, packaged in a 1.25 x 1.25 x 0.75 in. metal case, contain five SMA connectors, including one at each control port to maintain 3ns switching speed.

Switch fast... to Mini-Circuits' GaAs switches.

SPECIFICATIONS

Pin Model	KSW-2-46		KSWA-2-46	
Connector Version	ZFSW-2-46		ZFSWA-2-46	
FREQ. RANGE	dc-4.6 GHz		dc-4.6 GHz	
INSERT. LOSS (db)	typ	max	typ	max
dc-200MHz	0.9	1.1	0.8	1.1
200-1000MHz	1.0	1.3	0.9	1.3
1-4.6GHz	1.3	1.7	1.5	2.6
ISOLATION (dB)	typ	min	typ	min
dc-200MHz	60	50	60	50
200-1000MHz	45	40	50	40
1-4.6GHz	30	23	30	25
VSWR (typ) ON	1.3:1		1.3	
OFF	—		1.4	
SW. SPEED (nsec) rise or fall time	2(typ)		3(typ)	
MAX RF INPUT (bBm)				
up to 500MHz	+17		+17	
above 500MHz	+27		+27	
CONTROL VOLT.	-5V on, 0V off		-5V on, 0V off	
OPER/STOR TEMP.	-55° to +125°C		-55° to +125°C	
PRICE (1-24)	**$32.95**		**$48.95**	
	$72.95		**$88.95**	

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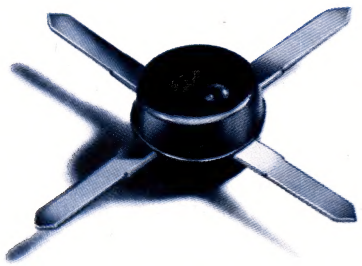
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CIRCLE NO 3

99¢

from



dc to 2000 MHz amplifier series

SPECIFICATIONS

MODEL	FREQ. MHz	GAIN, dB 100 MHz	1000 MHz	2000 MHz	Min. (note)	•MAX. PWR. dBm	NF dB	PRICE $ Ea.	Qty.
MAR-1	DC-1000	18.5	15.5	—	13.0	0	5.0	0.99	(100)
MAR-2	DC-2000	13	12.5	11	8.5	+3	6.5	1.50	(25)
MAR-3	DC-2000	13	12.5	10.5	8.0	+8□	6.0	1.70	(25)
MAR-4	DC-1000	8.2	8.0	—	7.0	+11	7.0	1.90	(25)
MAR-6	DC-2000	20	16	11	9	0	2.8	1.29	(25)
MAR-7	DC-2000	13.5	12.5	10.5	8.5	+3	5.0	1.90	(25)
MAR-8	DC-1000	33	23	—	19	+10	3.5	2.20	(25)

NOTE: Minimum gain at highest frequency point and over full temperature range.
• 1dB Gain Compression
□ +4dBm 1 to 2 GHz

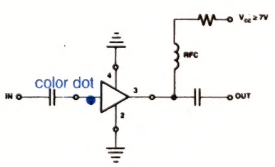
Unbelievable, until now…tiny monolithic wide-band amplifiers for as low as 99 cents. These rugged 0.085 in.diam.,plastic-packaged units are 50ohm* input/output impedance, unconditionally stable regardless of load*, and easily cascadable. Models in the MAR-series offer up to 33 dB gain, 0 to +11dBm output, noise figure as low as 2.8dB, and up to DC-2000MHz bandwidth.

*MAR-8, Input/Output Impedance is not 50ohms, see data sheet.
Stable for source/load impedance VSWR less than 3:1

designers amplifier kit, DAK-2

5 of each model, total 35 amplifiers

only $59.95



Also, for your design convenience, Mini-Circuits offers chip coupling capacitors at 12 cents each.†

Size (mils)	Tolerance	Temperature Characteristic	Value
80 × 50	5%	NPO	10, 22, 47, 68, 100, 470, 680, 100 pf
80 × 50	10%	X7R	2200, 4700, 6800, 10,000 pf
120 × 60	10%	X7R	.022, .047. .068, .1μf

† Minimum Order 50 per Value

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CIRCLE NO 4

Volume 33, Number 15

EDN

July 21, 1988

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS



On the cover: *Part 2 of EDN's Showcase No 27 completes our coverage of the significant new products and developments in four technology areas. Staff-written stories begin on pg 74, with a discussion of how adhesives can affect your designs. On pg 148, you'll find out how to shop for the right PC-based CAE software packages. The article starting on pg 240 suggests that, instead of trading in your computer, you can add a high-speed μP board for the power you need. And finally, what does "universal" mean when it describes a programmer and how much do you pay for it? Find out on pg 182. (Photography by Dana Sigall; art direction by Kathleen Ruhl)*

DESIGN FEATURES

Components and Materials

Adhesives spread to all phases of electronics 74

Although detailed expertise in adhesives is the purview of manufacturing engineers, electronics engineers should keep abreast of adhesive developments, which can affect electronic-design options.—*Charles H Small, Associate Editor*

Computer-Aided Engineering

Know the territory before you buy PC-based CAE software 148

Shopping for a PC-based CAD/CAE package means more than a casual browse through some published literature. There's simply too many variables involved. Knowing what the issues are and how they interrelate, along with trying some evaluation kits, can help you find the right package for your needs.—*Doug Conner, Regional Editor*

Instruments

Feature-packed universal programmers deliver good value 182

Universal programmers—ones that handle a wide variety of programmable logic devices in addition to PROMs, EPROMs, EEPROMs, and programmable μPs—fall at or near the top of most vendors' lines. How much is the security blanket of universality worth?—*Dan Strassberg, Associate Editor*

Computers and Peripherals

Add-in μP boards break various hosts' speed limits 240

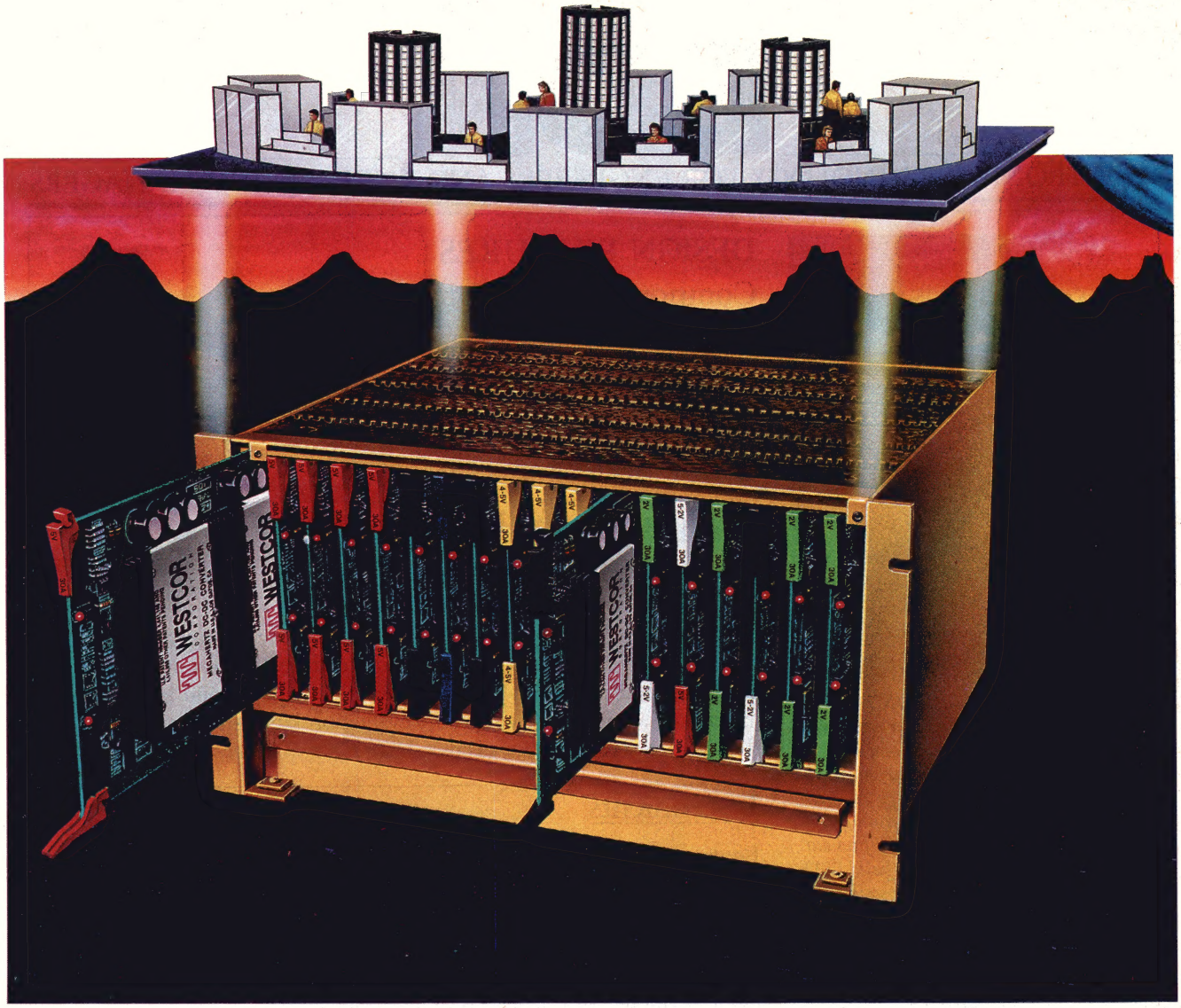
Before you trade in your computer for this year's latest model, consider adding a high-speed μP board to meet your expanding computing requirements. These boards, including some that offer parallel operations, can increase the power of the machine you already have—often ten- to twentyfold.—*John Gallant, Associate Editor*

1988 Product Database Index 299

EDN's database includes products that received coverage in EDN and EDN News between November 1987 and April 1988.

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A NEW WORLD OF HIGH POWER FLEXIBILITY

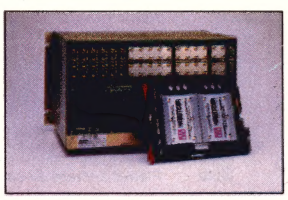
Westcor's PowerCage™ and PowerCards™ comprise a modular power supply system of galactic power (7200 watts max.), flexibility (36 outputs max.) and efficiency (80% typ.). More like an expandable computer mainframe in design and concept than a standard high power supply, the PowerCage offers space-age alternatives to users of outdated 5x8x11 inch box switchers.

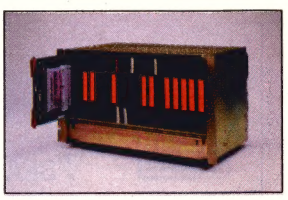
Measuring 19x10.5x11.25 inches deep the PowerCage fits into a standard NEMA rack and powers 18 slots for single or dual output PowerCards or dummy cards. PowerCage backplanes provide connections for easy configuration by the user.

Low profile (.8″) PowerCards supply single outputs from 2 to 75 VDC at up to 400 watts (outputs from 2 to 5 VDC limited to 60 amperes). Dual output cards source two isolated outputs each at half of the above ratings. Single output cards can be paralleled with current sharing to provide kilowatts via simple backplane configuration.

The nucleus of each PowerCage system is Westcor's patented 1 MHz, high power density, high reliability converter. Consider these benefits and features: 208 VAC 3 phase input; remote/local sense on all outputs; TTL power good signal and status LED's; designed to meet UL, CSA and VDE safety requirements; TTL inhibit; over-temperature, over-current, over-voltage protection; "hot" card insertion; full power at 50°C.

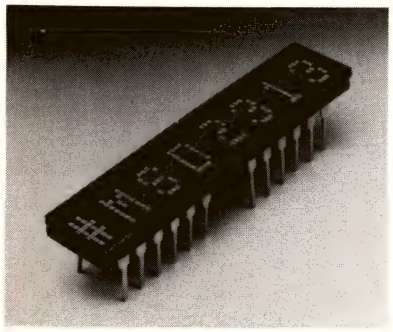
Future options include: DC input; IEEE-488 programmability; fault tolerant operation and battery backup. To discover a new world of high power flexibility, please contact us.





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CIRCLE NO 5



***Product coverage** begins on pg 91 with a section on new components, and continues with computer-aided engineering (pg 163), instruments (pg 195), and computers and peripherals (pg 253).*

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Compact power supply 60

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Compensate op amps without capacitors 331
Signal activates battery-powered circuit 332
Battery-sense circuit deactivates quickly 334

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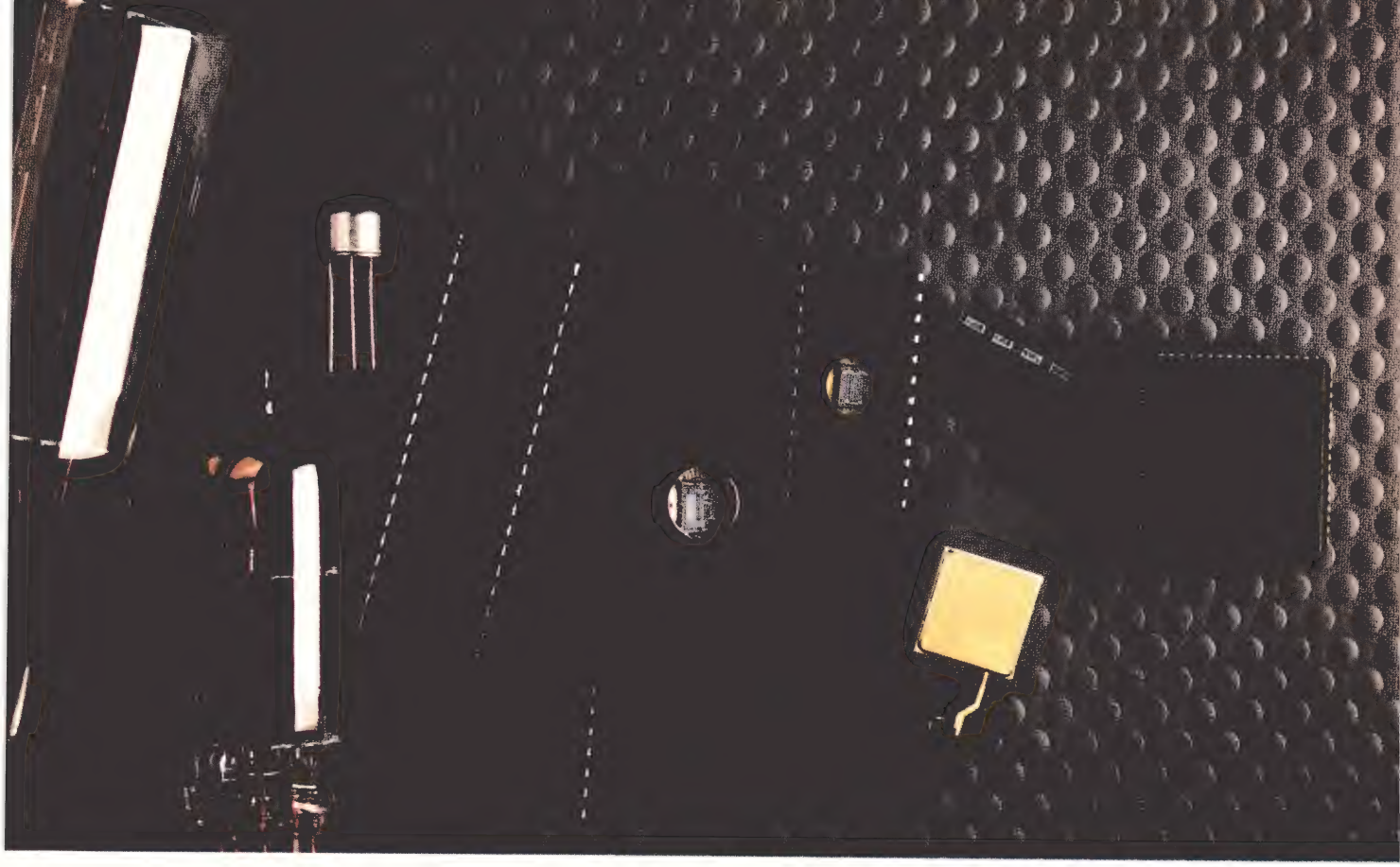
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PROGRAMMING TECHNOLOGY THAT SUPPORTS ADVANCED DESIGNS—TODAY AND TOMORROW. The UniSite™ 40's universal programming technology is the fastest and easiest way to keep up with new devices and packages. Its software-configured pin driver system provides a single site for programming any DIP device up to 40 pins, including PLDs, PROMs, IFLs, FPLAs, EPROMs, EEPROMs and microcontrollers. The same site accommodates the most popular surface-mount packages—PLCCs, LCCs and SOICs.

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CIRCLE NO 6

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EDITORIAL

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The furor over uncompensated overtime has finally reached Congress, but in light of Congress's own record, don't expect to see action soon.

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CAE bottleneck challenges project managers.

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A product-oriented design aid

To save you time in your efforts to keep current, EDN's editors have surveyed the new-product offerings from thousands of companies, screening and selecting only the most significant of those offerings introduced in the last six months. We present our findings—the best of the best—in a format designed to make your product selection as easy as possible. You can keep this Product Showcase as a reference until the next one that covers these four key product areas appears in December.

Professional Issues will return next issue.

SIEMENS

Consistent expansion of the SMD spectrum: eg discrete semiconductors from Siemens

If you're going to make full use of the benefits of surface mounting, as many discrete semiconductors as possible have to be available as SMDs.

So if you've hesitated to change to SMDs until now, it's time to think again. Firstly because you don't want to be left behind. Secondly because Siemens is already offering almost all its discrete semiconductors as SMDs.

Diodes, transistors, temperature sensors and LEDs all come as SMDs in proven SOT packages.

That's not all. Siemens also has opto-couplers in SO 8 format and micro-wave semiconductors in CEREC packages.

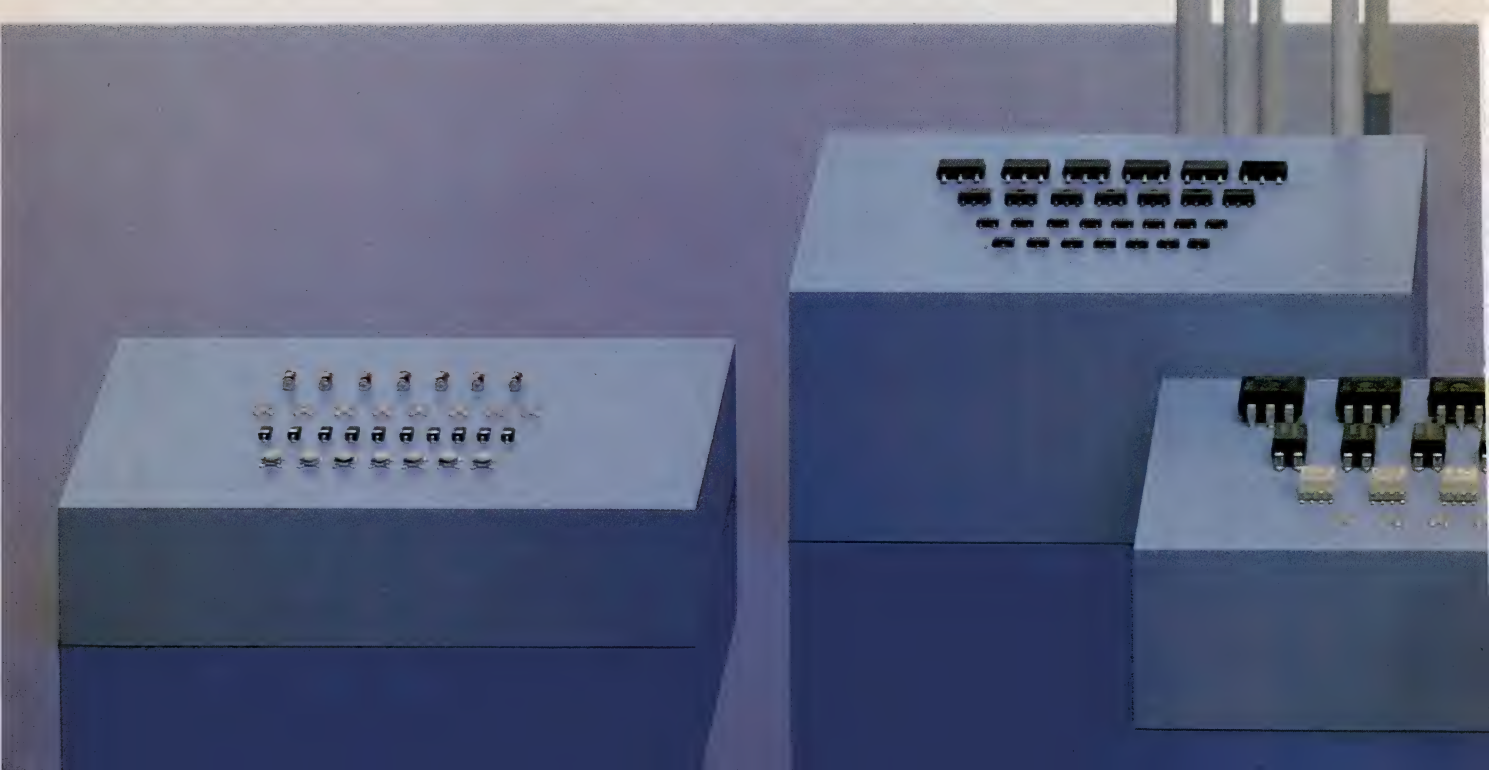
You only have to ask and Siemens, because of its longterm experience in SMDs, can very quickly come up with extra versions derived from classic ones.

But what's more, Siemens has developed libraries on electronic data media for its SMDs in which all numeric and graphic data are stored ready for CAD. That simplifies and rationalizes the work of PCB layout.

Siemens AG,
Components Group,
Balanstrasse 73,
D-8000 Munich 80

12/Z074e

CIRCLE NO 8




SMD

Stop Wasting Power



New CMOS array features the lowest power dissipation: 8μW/Gate/MHz

Raytheon's newest CMOS array family, the RL1000, helps you achieve optimum power performance. It offers the lowest power dissipation available—at high densities—without sacrificing speed.

☐ **Lowest Power:** Ratheon's 8μW/gate/MHz CMOS arrays, with 1.0 micron effective channel lengths, have available densities ranging from 5670 to 20,440 gates. With 20 tracks per channel instead of the standard 16, gate utilization is typically 90 percent or better.

☐ **High Speed:** At 0.3 ns unloaded inverter delay, this low-power, high-speed array family is perfect for portable equipment or where power sources are limited.

☐ **Other features:** The RL1000 series, with symmetrical switching delays, operates at 250 MHz flip-flop frequency and is TTL/CMOS compatible.

☐ **Packaging:** All packaging options are available. And Raytheon's design support includes an extensive macrocell library on major workstations.

☐ **Also available in CMOS:**
- Approved VHSIC PHASE I gate array: RVG 1.25 family
- Second source for LSI Logic Inc.'s LL7000 Series: RL7000

Call Raytheon for access to the right CMOS technology. Your success is our first priority.

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Mountain View, CA 94039-7016
(415) 966-7716

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CIRCLE NO 9

A 155MB 3.5" Format Cassette Data Streamer?



MT-2ST/N50



Yes, *155MB* on the TEAC MT-2ST/N50. In a data streamer the size of a standard 3.5" microfloppy disk drive—including SCSI interface. With backup under software control for everything from a single file to an entire hard disk. And read-after-write data verification with sophisticated error correction for the highest data integrity.

A surprising extra: full media compatibility. So that a backup cassette made on one data streamer can be read on any other. This makes data cassettes an ideal means of exchanging or distributing large volumes of data.

Less surprising is the fact that the few Japanese computer manufacturers who haven't already adopted the MT-2ST/N50 are actively considering it. There just isn't any comparable alternative . . . not in size, capacity, or compatibility. And there probably won't be, until we finalize a second-source licensing agreement!

TEAC

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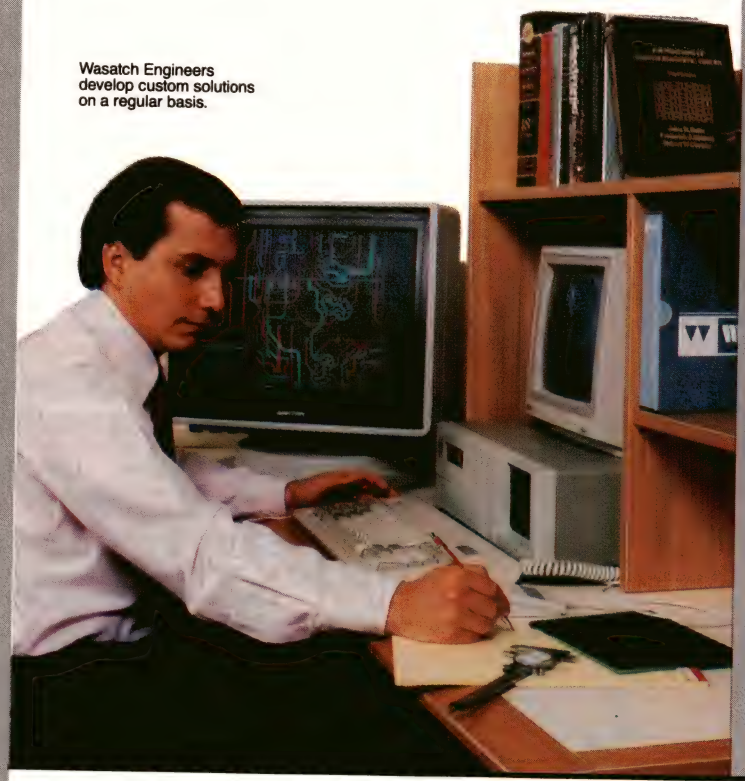
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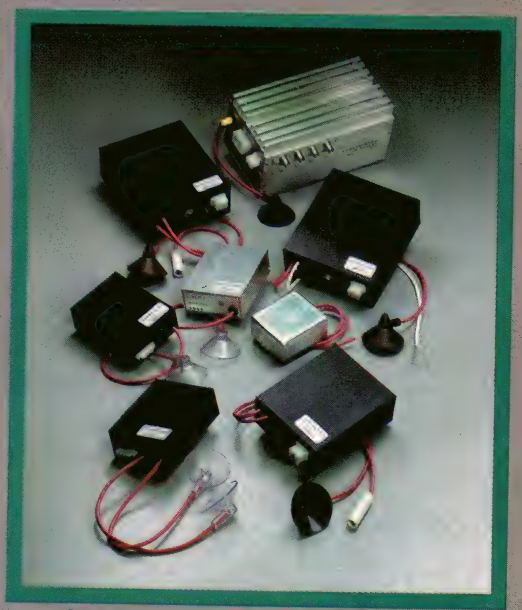
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Rep Inquiries Welcome

CIRCLE NO 15

NEWS BREAKS

EDITED BY JOANNE CLAY

LOGIC ANALYZER SUPPORTS 25-MHz 68030 MICROPROCESSOR

The PM206 68030 personality module and the 12RM33 68030 mnemonics ROM pack, both from Tektronix (Beaverton, OR, (503) 629-1265) are the first logic-analyzer support products available for the 68030 microprocessor. The personality module and ROM pack allow you to interface Tektronix's 1240/1241 logic analyzers to a 68030 microprocessor operating at clock rates as high as 25 MHz. A low-capacitance probe connector joins the personality module to the 68030's 128-pin PGA socket. The personality module acquires all valid 68030 bus cycles, including asynchronous, synchronous, and burst data transfers. The mnemonics ROM pack disassembles the 68030 microprocessor and 68881/68882 floating-point-coprocessor instruction sets. By automatically tracking the 68030's 3-stage instruction pipeline, the ROM pack can mark the instructions that are executed. The ROM pack also decodes the 68030's dynamic bus sizing and displays only the 68030 data that is actually transferred. The total package, including the logic analyzer, costs $10,950. The ROM pack and personality module cost $3500.—Doug Conner

CD ROM ABSORBS MORE THAN 10,000 PAGES OF UNIX DOCUMENTATION

Searching for technical information regarding AT&T's Unix can be daunting—the operating system's documentation takes up more than 10,000 printed pages. Hewlett-Packard's (Palo Alto, CA; phone local office) LaserROM package for its HP-UX version of Unix allows you to search for such information electronically. LaserROM is sold by subscription and costs $1800 for 12 monthly updates. If you order a 12-month subscription to the LaserROM service before December 31, 1988, the company will include a 5¼-in. CD ROM drive for use in an HP Vectra or IBM PC/AT-compatible computer at no additional charge.—Steven H Leibson

SOFTWARE MONITOR CREATES BATTERY "FUEL GAUGE" FOR LAPTOP PCs

Users of battery-powered, laptop PCs often become apprehensive after using their machines for extended periods because their machines provide no means for measuring the remaining battery capacity. To ease their fears, they can take advantage of Battery Watch, a $39.95 terminate-and-stay-resident (TSR) program from Traveling Software (Bothell, WA, (206) 483-8088). The program, which runs on a variety of MS-DOS-based laptop PCs, provides an estimation of the time remaining before batteries will require recharging. The program doesn't actually measure the PC's battery voltage. Instead, it checks the state of the computer every two seconds to determine what peripherals are in use. With that information, the program calculates the instantaneous battery drain, computes the remaining battery capacity, and displays the result of that computation on the PC in the form of a bar chart.—Steven H Leibson

STAND-ALONE IEEE-488 CONTROLLER OPERATES WITHOUT SUPERVISION

You can now provide IEEE-488 control outside your laboratory with the Macro488 from IOtech (Cleveland, OH, (216) 439-4091). The Macro488 can also free your host computer from monitoring IEEE-488-based instruments. You just load as many as 100 instruction sets into the unit's 32k bytes of nonvolatile RAM from any computer having an RS-232C or RS-422 data port, and the Macro488 will control as many as 14 IEEE instruments. You can also retrieve data collected by the unit through your computer's serial port. A built-in real-time clock lets the unit collect data at regular or irregular intervals, so it can operate without supervision. The clock also provides time-stamping capability. The Macro488's solid-state design makes it suitable for field testing applications. It sells for $995.—J D Mosley

NEWS BREAKS

INDUSTRIAL-STRENGTH PC HOUSES 14 EXPANSION BOARDS

For industrial applications that require an IBM PC or compatible computer with lots of data-processing flexibility and extensive memory capacity, consider the Model 3014 computer from Texas Microsystems (Houston, TX, (800) 627-8700 or (713) 933-8050). You can order this computer with an 8086-, 80286-, or 80386-based CPU board, any combination of 8- and 16-bit card slots, and as many as five disk drives for a maximum of 1G byte of mass data storage. The nickel-plated steel enclosure includes a dual-fan cooling system, clamping mechanisms to ensure stable connections for your expansion boards despite vibration or shock, an internal ground plane with ground shields for each signal, and a lockable transparent door to protect the disk drives. A typical 80286-based system with 1M byte of RAM sells for $2700.—J D Mosley

STATIC RAMs OFFER DENSITY OR SPEED

If you need a high-density SRAM or need to operate with a 15-nsec access time, Hitachi America (San Jose, CA, (408) 435-8300) has a part for you. The HM628128 is a 1M-bit static RAM organized as 8×128k bits and offering a 70-nsec access time. The part comes in a 32-pin plastic DIP or surface-mount package. Samples of the part are available now for $220; it's scheduled to be in full production in early 1989. The HM6787, HM6788, and HM6789 are 64k-bit parts with 15-nsec access times. The 64k×1-bit HM6787, 16k×4-bit HM6788, and 16k×4-bit HM6789 (which offers an output-enable function) are TTL compatible; their prices start at $59.10 (100).—Richard A Quinnell

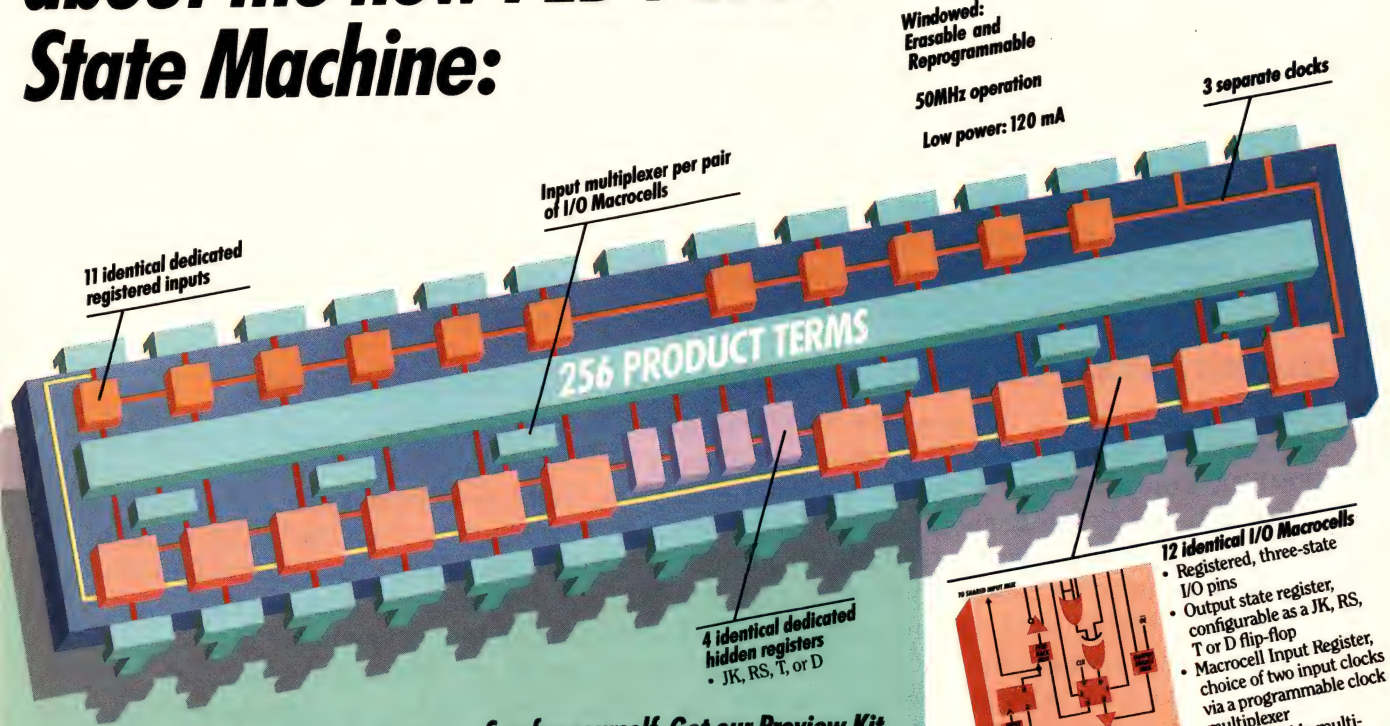
LITHIUM-POWERED μC SCHEDULES AND LOGS EVENTS

Capable of time-stamping events and scheduling activities by date and time, the DS5000T from Dallas Semiconductor (Dallas, TX, (214) 450-0400) is a CMOS single-chip microcontroller with a built-in lithium energy source, a real-time clock/calendar, and 32k bytes of nonvolatile static RAM for program and data storage. You can partition the RAM as program space and data space to suit your particular task. The chip's crash-proof circuitry permits it to resume a task—with no loss of data—after a system-wide power blackout. A built-in encryptor maintains the confidentiality of proprietary application software and data. And the DS50000T can receive new programming or report logged information via a telephone connection, thus permitting you to update software without interrupting service, removing the chip, or opening the equipment's enclosure. You can order this device with 32k bytes of RAM for $80.75 (1000) or select the 8k-byte version, which sells for $64 (1000).—J D Mosley

LOGIC ANALYZER ALSO ACTS AS SYMBOLIC DEBUGGER AND DATA LOGGER

The Mobile Incident Logger (MIL) from Step Engineering (Sunnyvale, CA, (408) 733-7837) combines the functions of a logic analyzer, a symbolic debugger, and a data logger in a portable package. The instrument requires an IBM PC or compatible computer to act as a host for data transfer and for initialization. You can program the MIL to acquire analog data, log digital events, and record microcontroller operation. After setup, the unit can acquire and store data independentlyof the host. The unit can time-tag data for interleaved display, or it can let you view the data types separately. The unit supports the 6800 Series of microcontrollers as well as the 68000 Series. Not including the host, the MIL costs $14,900 and is available for delivery within 30 days ARO.—Richard A Quinnell

Why high performance designers are so excited about the new PLD 7C330 State Machine:



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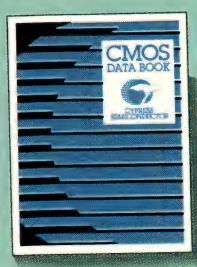
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NEWS BREAKS: INTERNATIONAL

SUBMICRON CMOS GATE ARRAYS OFFER 3000 TO 45,000 GATES

Matra Harris Semiconducteurs (Nantes, France, TLX 711930; in the US: Santa Clara, CA, (408) 986-9000) is now accepting designs for the company's MC series of submicron gate arrays. The devices are manufactured with a CMOS process and have an effective channel length of 0.65 μm (1 μm drawn). The initial introductions are a 10,000-gate device and a 35,000-gate device. Production of these devices is scheduled for the first and second quarters of 1989. During 1989, the company will complete the series with gate arrays that range in complexity from 3000 to 45,000 gates. MC Series gate arrays have a typical gate propagation delay of 0.5 nsec and accept clock frequencies as high as 100 MHz. They cost approximately £1 per 1000 gates (5000). In 1989, you'll also be able to obtain the MCM Series, which will have similar technology, but will have a portion of the die precustomized with optimized blocks such as RAM; the remaining portion of the die will be a gate array.—Peter Harold

SEALED KEYBOARDS FEATURE DAYLIGHT-VISIBLE BACKLIGHTING

Marconi Electronic Devices' Microsystems Div (Swindon, UK, TLX 444460; in the US: Hauppauge, NY, (516) 231-7710) can now supply LED backlighting for its SF62000-Input range of ruggedized, fully sealed, conductive rubber keyboards. Each keyswitch location incorporates both red and green surface-mount LEDs, which provide even illumination of the keyswitch through its keycap legend area. The illumination is bright enough to be clearly visible in daylight. You can individually address each LED in the keyboard array, so you can generate red, green, or yellow keyswitch illumination. The LEDs don't affect the keyboards' 1.4-mm switch travel or their tactile feedback. However, the backlighting does approximately double the price in comparison with the company's unlit versions: A 12-way backlit keyboard sells for around $103.—Peter Harold

PERSONAL NEUROCOMPUTER SPEEDS SOFTWARE-DEVELOPMENT TASKS

According to reports in the Japanese press, NEC has become the first company to offer a personal "neurocomputer," a system that comprises the company's PC9800 personal computer, a neuro engine board, and a neural-network program. The neuro engine board includes four data-flow-type microprocessors for high-speed parallel processing. The computer will reportedly let users complete software-development tasks for a variety of systems—such as character-recognition systems, expert systems with learning capability, voice-recognition systems, amd robot-control systems—in about a tenth of the time they'd require with conventional computers. The personal computer's arithmetic-processing capability is rated at approximately the level of a minicomputer. It costs about $5440 to $11,198, depending on the configuration.—Joanne Clay

US FIRM SIGNS MAJOR AGREEMENT WITH CHINESE COMPUTER MAKER

US semiconductor and board manufacturer Western Digital Corp (Irvine, CA, (714) 863-0102) recently announced that it has signed an agreement with China Computer Development Corp (CCDC) of the People's Republic of China. CCDC will purchase as much as $3 million worth of Western Digital's WD1003-WA2 and -RA2 hard-disk-controller boards and chip sets and incorporate them in CCDC's Great Wall family of computer products, which the Chinese company markets in the Western Hemisphere through Wescom Inc (Santa Fe Springs, CA). The agreement will also license CCDC to use Western Digital chip sets to build and sell its own board-level products to other computer firms in the People's Republic of China. The accord is contingent upon US government approval.—Joanne Clay

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RIMFIRE 1500
SCSI Adapter for Multibus® I

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CIRCLE NO 17

rugged plug-in amplifiers



0.5 to 1000MHz from $13.95 (5 to 24 qty)

Tough enough to meet full MIL-specs, capable of operating over a wide -55° to +100°C temperature range, in a rugged package...that's Mini-Circuits' new MAN-amplifier series. The MAN-amplifier's tiny package (only 0.4 by 0.8 by 0.25 in.) requires about the same pc board area as a TO-8 and can take tougher punishment with leads that won't break off. Models are unconditionally stable and available covering frequency ranges 0.5 to 500MHz and 0.5 to 1000MHz, and NF as low as 2.8dB.

Prices start at only $13.95, ***including*** screening, thermal shock -55°C to +100°C, fine and gross leak, and burn-in for 96 hours at 100°C under normal operating voltage and current.

Internally the MAN amplifiers consist of two stages, including coupling capacitors. A designer's delight, with all components self-contained. Just connect to a dc supply voltage and get up to 28dB gain with +9dBm output.

The new MAN-amplifier series... another Mini-Circuits' price/performance breakthrough.

MODEL	FREQ. RANGE (MHz) f_L to f_u	GAIN dB min	flatness††	MAX. OUT/PWR† dBm	NF dB (typ)	DC PWR 12V, mA	PRICE $ ea. (5-24)
MAN-1	0.5-500	28	1.0	8	4.5	60	13.95
MAN-2	0.5-1000	19	1.5	7	6.0	85	15.95
MAN-1LN	0.5-500	28	1.0	8	2.8	60	15.95
◇MAN-1HLN	10-500	10	0.8	15	3.7	70	15.95

†† Midband 10f_L to $f_{u/2}$, ± 0.5dB † 1dB Gain Compression ◇Case Height 0.3 In.
Max input power (no damage) +15dBm; VSWR in/out 1.8:1 max.

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CIRCLE NO 18

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LOW PASS Model *LP-	10.7	21.4	30	50	70	100	150	200	300	450	550	600	750	850	1000
Min. Pass Band (MHz) DC to	10.7	22	32	48	60	98	140	190	270	400	520	580	700	780	900
Max, 20dB Stop Frequency (MHz)	19	32	47	70	90	147	210	290	410	580	750	840	1000	1100	1340

Prices (ea.): P $9.95 (6-49), B $24.95 (1-49), N $27.95 (1-49), S $26.95 (1-49)

HIGH PASS Model *HP-		50	100	150	200	250	300	400	500	600	700	800	900	1000
Pass Band (MHz)	start, max.	41	90	133	185	225	290	395	500	600	700	780	910	1000
	end, min.	200	400	600	800	1200	1200	1600	1600	1600	1800	2000	2100	2200
Min. 20dB Stop Frequency (MHz)		26	55	95	116	150	190	290	365	460	520	570	660	720

Prices (ea.): P $12.95 (6-49), B $27.95 (1-49), N $30.95 (1-49), S $29.95 (1-49)

*Prefix P for pins, B for BNC, N for Type N, S for SMA *example:* **PLP-10.7**

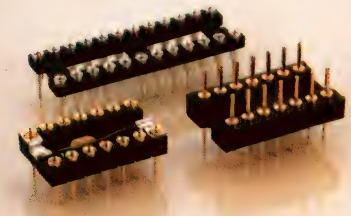
C105 REV.D

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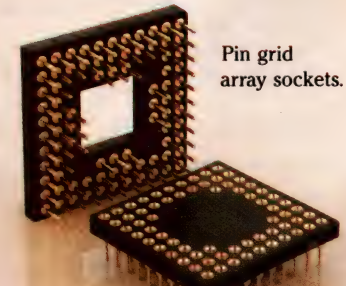
DIP sockets, capacitor sockets, adaptor plugs.



Square socket strips, board spacers.



Pin grid array sockets.



Samtec's fair price and ADDED VALUES give you more for your money in ways that really count!" *Sam Shine, Proprietor*



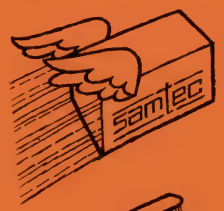
ADDED VALUE–**Triple inspection of all parts**—before and after assembly and during packaging. You get the *right* components in perfect condition.



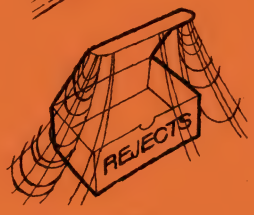
ADDED VALUE–**Fast, friendly sales and order entry staff.** Technical answers by trained people who know Samtec products as well as competitive units.



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Interconnect Guide plus New 100-page Catalog. Guide is valuable reference for keeping up with new interconnect products and applications. New Catalog has specs on all Samtec interconnects.

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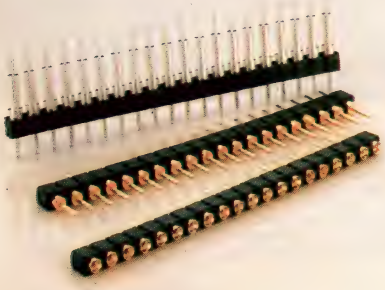
samtec

EUROPEAN HEADQUARTERS: **SAMTEC, Ltd.** 35 Deerdykes View, Westfield, Cumbernauld, Scotland G68 9HN Phone: 02367 39292 FAX: 2367 27113 TLX: 776158

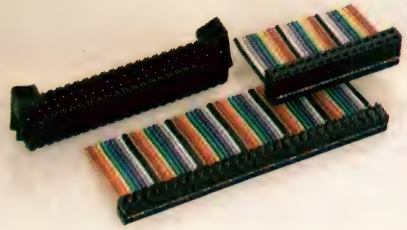
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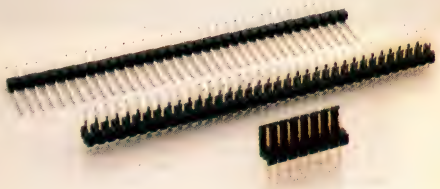
Machined sockets, terminal strips.



Shrouded IDC terminal strips, matching cable strips.



.025" sq. terminal strips, single/double row, shrouded.



CIRCLE NO 20

THINK FAST. TOSHIBA



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HIGH SPEED STATIC RAMS.

From bit-wide to byte-wide, from 25ns to 70ns, Toshiba is the power — and the speed — in static RAMs.

When you think fast, think Toshiba. We have the organizations and the speeds to meet your requirements. In the popular 4K x 4, we offer a 25ns version in the standard 20 pin type and in a 22 pin version with an output enable function of 15ns. The output enable helps eliminate bus contention while increasing speed.

We were first with 2K x 8 devices which are ideally suited for cache memory applications. We now have a 25ns version in addition to our 35ns offering. Both are now available in plastic DIPs.

For high speed bit-wide applications, we are in full production of two versions of our CMOS 64K x 1 SRAMs. One with access times to 35ns, and one with the lowest standby power in the industry at only 100μA. Both plastic DIP and plastic SOJ packaging are available.

A new product introduction is the 16K x 4 CMOS static RAM with access time of 25ns. Standard 22 pin plastic DIP and SOJ versions are available, as well as a 24 pin plastic DIP and SOJ version with output enable access time of 15ns.

For byte-wide applications we have an 8K x 8 device with access times to 35ns. Packaging is 28 pin 300 MIL plastic DIP. For applications where parity is required, we have an 8K x 9 with speeds to 35ns. This device is also in a 300 MIL plastic DIP.

So when you're thinking fast, think Toshiba. The power in high speed SRAMs.

FAMILY TYPE: HIGH SPEED MOS STATIC RAMS					
PART	ORG'N	SPEED	PACKAGE	SAMPLES	PROD'N
TMM2068AP	4KX4	45	20P DIP	NOW	NOW
TMM2068AP	4KX4	35	20P DIP	NOW	NOW
TMM2068AP	4KX4	25	20P DIP	NOW	NOW
TMM2018AP	2KX8	45	24P DIP	NOW	NOW
TMM2018AP	2KX8	35	24P DIP	NOW	NOW
TMM2018AP	2KX8	25	24P DIP	NOW	NOW
TMM2089C	8KX9	45	28P SB DIP	NOW	NOW
TMM2089C	8KX9	35	28P SB DIP	NOW	NOW
TMM2089P	8KX9	45	28P DIP	NOW	NOW
TMM2089P	8KX9	35	28P DIP	NOW	NOW
TMM2088P	8KX8	45	28P DIP	NOW	NOW
TMM2088P	8KX8	35	28P DIP	NOW	NOW
TC55416P	16KX4	45	22P DIP	NOW	NOW
TC55416P	16KX4	35	22P DIP	NOW	NOW
TC55416P	16KX4	25	22P DIP	NOW	NOW
TC55416J	16KX4	45	24P SOJ	NOW	NOW
TC55416J	16KX4	35	24P SOJ	NOW	NOW
TC55416J	16KX4	25	24P SOJ	NOW	NOW
TC55417P	16KX4	45	24P DIP	NOW	NOW
TC55417P	16KX4	35	24P DIP	NOW	NOW
TC55417P	16KX4	25	24P DIP	NOW	NOW
TC55417J	16KX4	45	24P SOJ	NOW	NOW
TC55417J	16KX4	35	24P SOJ	NOW	NOW
TC55417J	16KX4	25	24P SOJ	NOW	NOW
TC5561P	64KX1	70	22P DIP	NOW	NOW
TC5561P	64KX1	55	22P DIP	NOW	NOW
TC5561P	64KX1	45	22P DIP	NOW	NOW
TC5561J	64KX1	70	24P SOJ	NOW	NOW
TC5561J	64KX1	55	24P SOJ	NOW	NOW
TC5561J	64KX1	45	24P SOJ	NOW	NOW
TC5562P	64KX1	55	22P DIP	NOW	NOW
TC5562P	64KX1	45	22P DIP	NOW	NOW
TC5562P	64KX1	35	24P DIP	NOW	NOW
TC5562J	64KX1	55	24P SOJ	NOW	NOW
TC5562J	64KX1	45	24P SOJ	NOW	NOW
TC5562J	64KX1	35	24P SOJ	NOW	NOW

NOTE: DIP = PLASTIC CDIP = CERDIP SB DIP = SIDE BRAZED CERAMIC
SOJ = SMALL OUTLINE J LEAD PACKAGE

TOSHIBA.
THE POWER IN HIGH SPEED SRAMS.

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CIRCLE NO 22

SIGNALS & NOISE

Taiwan is relatively stable

In his editorial "Trouble in the Pacific" (EDN, April 28, pg 47), Jon Titus said that "only about 15% of Taiwan's population is from mainland China." Actually, more than 99% of Taiwan's population is from mainland China. Except for the much less than 1% who are truly native (ethnic) Taiwanese, most people in Taiwan are ethnic Chinese. The "15% of Taiwan's population from mainland China" that the editorial mentions are actually those who went (or whose parents or grandparents went) to Taiwan after the communist and nationalist civil war in the late 1940s. The people Jon refers to as "native Taiwanese" are people whose ancestors went from mainland China to Taiwan before World War II.

I believe that most people in Taiwan—except for extremely few Koumintang old-timers—do not believe their government should "lay claim to mainland China." I would also like to point out that Dr Li, the current president of Taiwan and the head of the Koumintang party, was born in Taiwan and speaks the Taiwanese dialect.

The Koumintang party is interested in making a smooth transition to majority rule. Compared to Korea or Hong Kong or Singapore, Taiwan is very stable.

Y Simon Tsuo
Solar Energy Research Institute
Golden, CO

Terminal talks on two

The March 17 issue of EDN contained a Design Idea by Sebastiao Santiago Barretto for an RS-232C spy circuit ("Spy terminal monitors RS-232C traffic," pg 205). The idea is elegant and clever, but it can't work as printed. To fix it, you must make the resistor go to pin 2 of the spy terminal, rather than pin 3. Also, you must swap references to pin 2 and 3 in the text. The circuit would work as shown if the spying device were a DCE, but terminals are DTE devices.

Long ago, I invented an alliteration that helps me remember which of pins 2 and 3 is the input and which is the output on DTE and DCE RS-232C devices. Just remember: "Terminal talks on two."

Dean A Cuadra
Cuadra Associates Inc
Los Angeles, CA

Chip speaks Forth

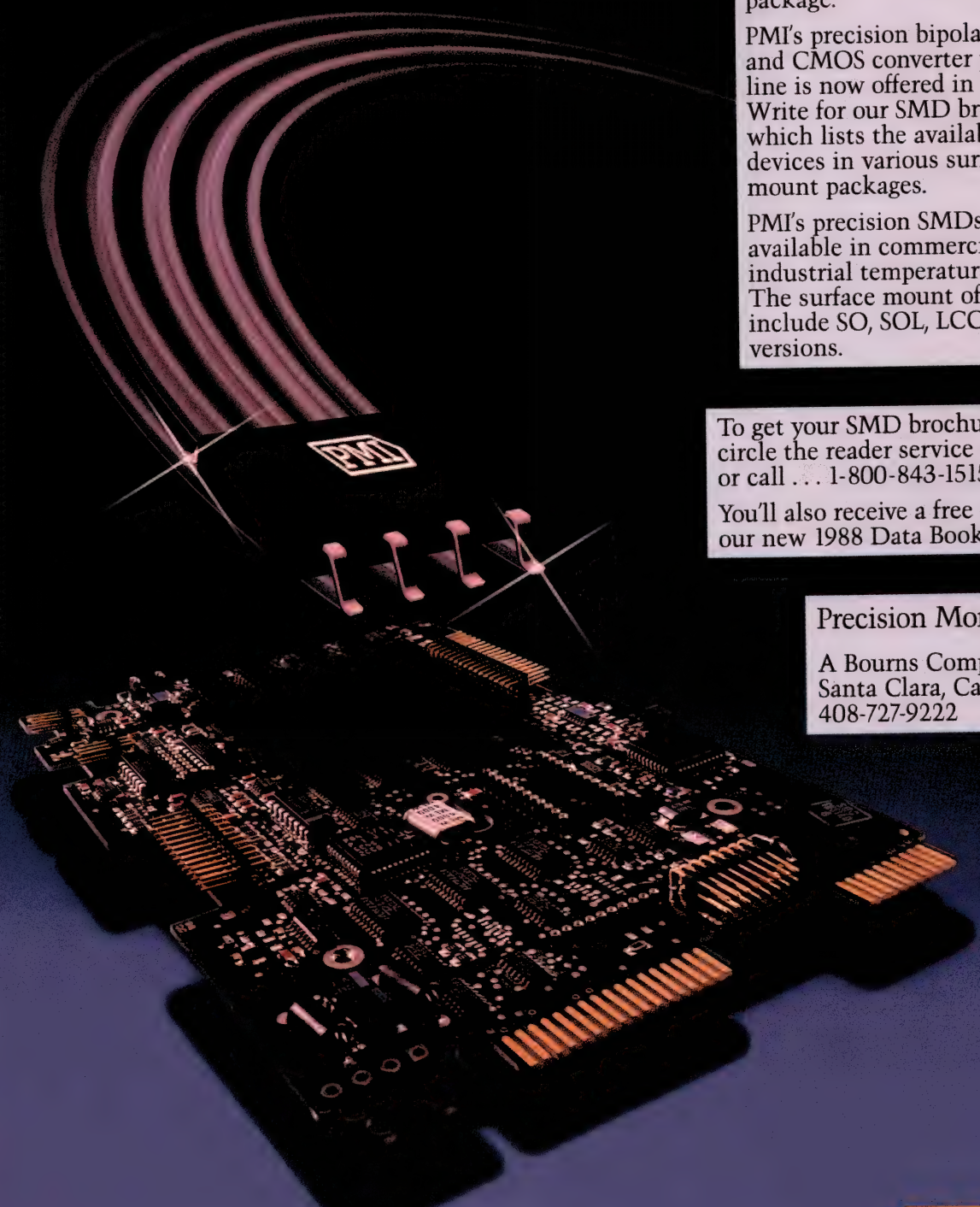
I read with great interest the Technology Update entitled "Plug-in boards let your personal computer perform parallel-processing tasks" (EDN, February 4, pg 89), by J D Mosley. It should be noted that the Novix NC4016 RISC that J D mentioned (on pg 96) performs high-level Forth words per cycle instead of assembly instructions. There is no assembly language for the Novix chip. In addition, Harris offers the AT/Force coprocessor, which implements Forth directly in silicon, as opposed to Novix's Forth interpreter, which is stored in a high-speed memory. Harris claims its coprocessor performs 10 million to 20 million Forth words/sec.

Dr Wayne J Naimoli
Director
Gazza Lab
Oakdale, NY

YOUR TURN

EDN's Signals and Noise column provides a forum for readers to express their opinions on issues raised in the magazine's articles or on any topic that affects the engineering industry. Send your letters to the Signals and Noise Editor, 275 Washington St, Newton, MA 02158. We welcome all comments, pro or con. All letters must be signed, but we will withhold your name upon request. We reserve the right to edit letters for space and clarity.

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CIRCLE NO 23

OLD WAY

OUR WAY

An integral 500 MHz, 10-digit counter/timer in Tek's new 11300 Series oscilloscopes opens up a world of accurate timing measurements never seen before.

In the old way, you had to use a separate oscilloscope to determine the gate's size and position, the pulse or time interval to be measured by your counter/timer.

Further, the trace blooming or limited writing rate of conventional CRT displays couldn't show high speed signals—such as glitches and narrow pulses—at low rep rates.

That made real accuracy nearly impossible.

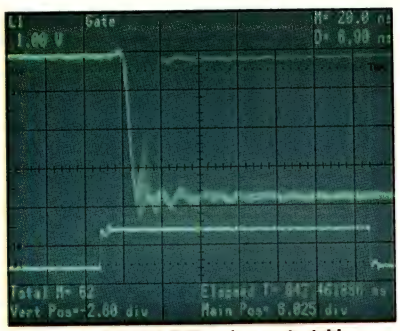
Our way, you not only have an integral counter/timer—you have a window into exactly what the counter/timer sees: using the 11300's unique counter view trace, you can observe precisely on what part of your signal the counter is triggering.

In other words, what you see is exactly what you get.

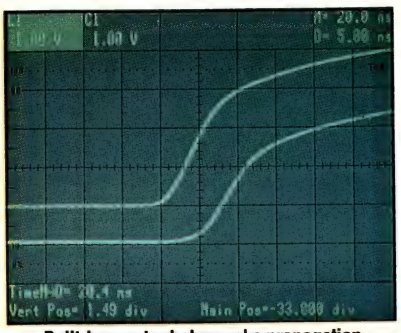
View fast transients invisible before, using the 11302's microchannel plate CRT. *Its 6 div/ns visual writing rate is more than a thousand times brighter than conventional oscilloscopes.*

Dual delayed sweeps, one-button calibration for enhanced accuracy, 8-channel display—these and much more help you see details and make comparisons where you've been flying blind before.

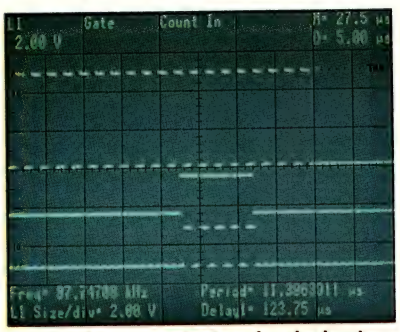
Ask your Tek representative for an 11300 Series demonstration—and start seeing things our way. *Or call (800) 835-9433, Ext. 170 for more information.*



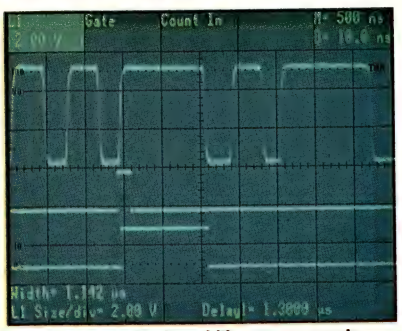
Microchannel CRT makes metastable events visible. Counter shows total number of events during elapsed time.



Built-in counter helps make propagation delay measurements with unprecedented accuracy and repeatability.



Gated frequency: top trace is pulse burst input; center is counter gate; bottom is view of what's being counted.



Make gated pulse width measurements with counter accuracy. Center is counterview trace, bottom clearly shows pulse width measured.



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CIRCLE NO 24


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Why you'll find us to be the beacon of miniature lamps.

It's really quite simple: others offer you a product, we offer a company. And a commitment.

It's also simple to prove. Next time the rep who fills your miniature lamp needs is in, ask him for performance data, too. Or a competitive analysis, or quarterly product audit and reliability test data. Or a legacy of excellence like we began with Chicago Miniature.

You get the idea. VCH not only has these capabilities and credentials, but we can provide them to you *in this country.* If you need help, VCH will send a specialist who talks your language and can be available in a few hours for design engineering assistance or applications advice.

Compare that with the infuriating alternatives: transoceanic phone calls and cables, garbled facts and data, and unfulfilled next-day promises.

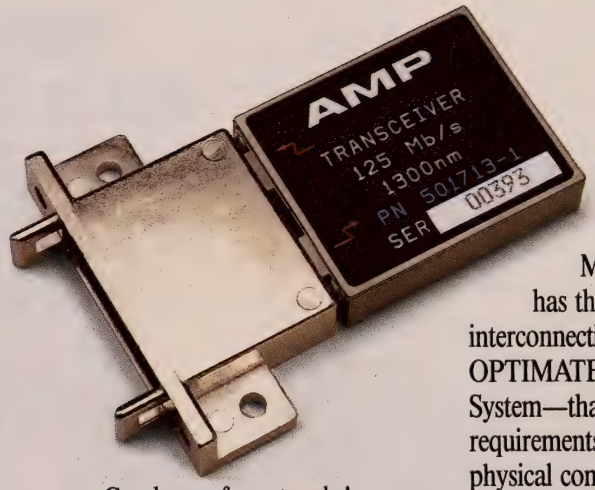
VCH looks at commitment as much more than a management buzzword. We're putting a new plant, an eager staff, and considerable resources where our mouth is. All this shows our dedication to the proposition that...nobody is going to out-service us. Nobody.

VCH...Three letters that stand for a whole new level in miniature lamp performance. We've rewritten the industry standards before, with Chicago Miniature. Now we're ready to do it again.



FDDI.

From deskwork to network.

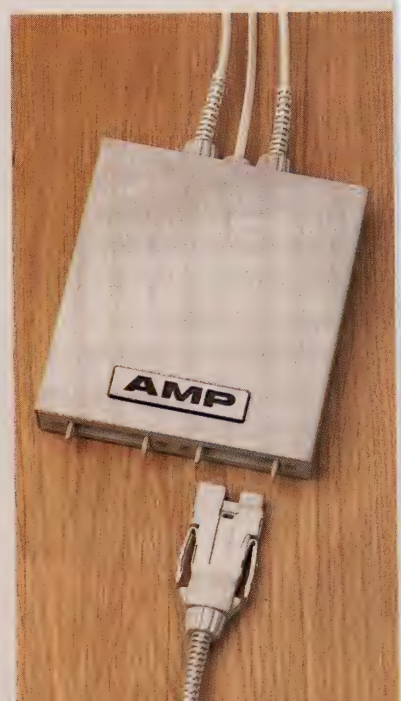


Good news for networks!

The X3T9.5 Task Group, under the procedures of ANSI Accredited Standards Committee X3, has reaffirmed approval of the Media Interface Connector (MIC) for the proposed FDDI (Fiber Distributed Data Interface) Physical Layer Medium Dependent (PMD) document.

More good news! AMP has the complete fiber optic interconnection system—the AMP OPTIMATE Fixed Shroud Duplex System—that meets all FDDI PMD requirements. And includes all the physical components you need to make your fiber optic network a reality.

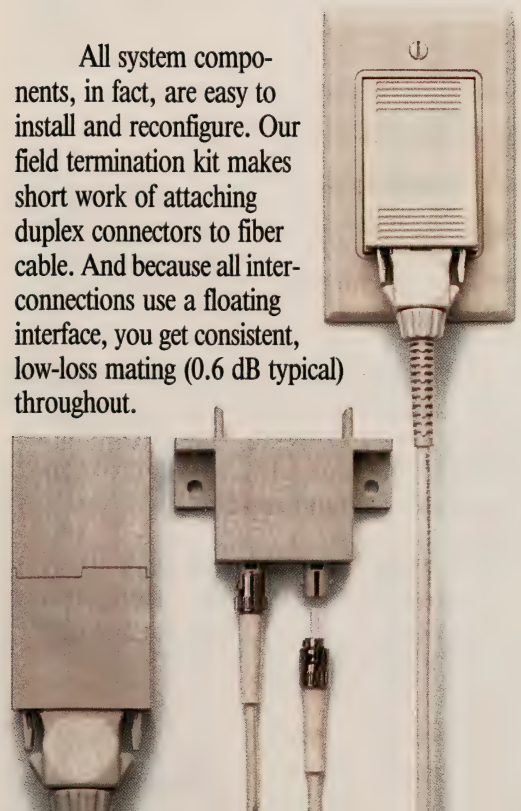
Of special note: the transceiver —the first of its kind—is capable of operating at data rates up to 125 Mb/s. Available in standard or raised (+5v) ECL logic, it gives you a compact, board-mount data link in a single 24-pin module. Reliable duplex mating and electro-optic conversion are now easier than ever.



AMP and OPTIMATE are trademarks of AMP Incorporated.



All system components, in fact, are easy to install and reconfigure. Our field termination kit makes short work of attaching duplex connectors to fiber cable. And because all interconnections use a floating interface, you get consistent, low-loss mating (0.6 dB typical) throughout.



You can also order complete, custom-built cable assemblies from us. Either way, you'll have the assured compatibility that comes from dealing with only one supplier for all your FDDI interconnection components. A supplier whose capability in fiber optic technology is everything you'd expect from the world's largest connector company.

For technical literature and more information, call 1-800-522-6752. AMP Incorporated, Harrisburg, PA 17105-3608.

AMP Interconnecting ideas

CIRCLE NO 26

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ThermaPro-V. Precise applications for sensitive equipment. Thermal management.

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CIRCLE NO 28

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CALENDAR

Principles of RF and Microwave Circuit Design (short course), College Park, MD. Besser Associates, 3975 E Bayshore Rd, Palo Alto, CA 94303. (415) 969-3400. July 25 to 27.

Siggraph, Atlanta, GA. Barbara Voss, Robert P Kenworthy Inc, 866 United Nations Plaza, Suite 424, New York, NY 10017. (212) 752-0911. August 1 to 5.

International Conference on Handheld Computing, Corvallis, OR. Eric Gakstatter, ICHC, 301 NE Byron Pl, Corvallis, OR 97330. (503) 752-5456. August 4 to 6.

Midcon, Dallas, TX. Electronic Conventions Management, 8110 Airport Blvd, Los Angeles, CA 90045. (800) 421-6816; in CA, (213) 772-2965. August 30 to September 1.

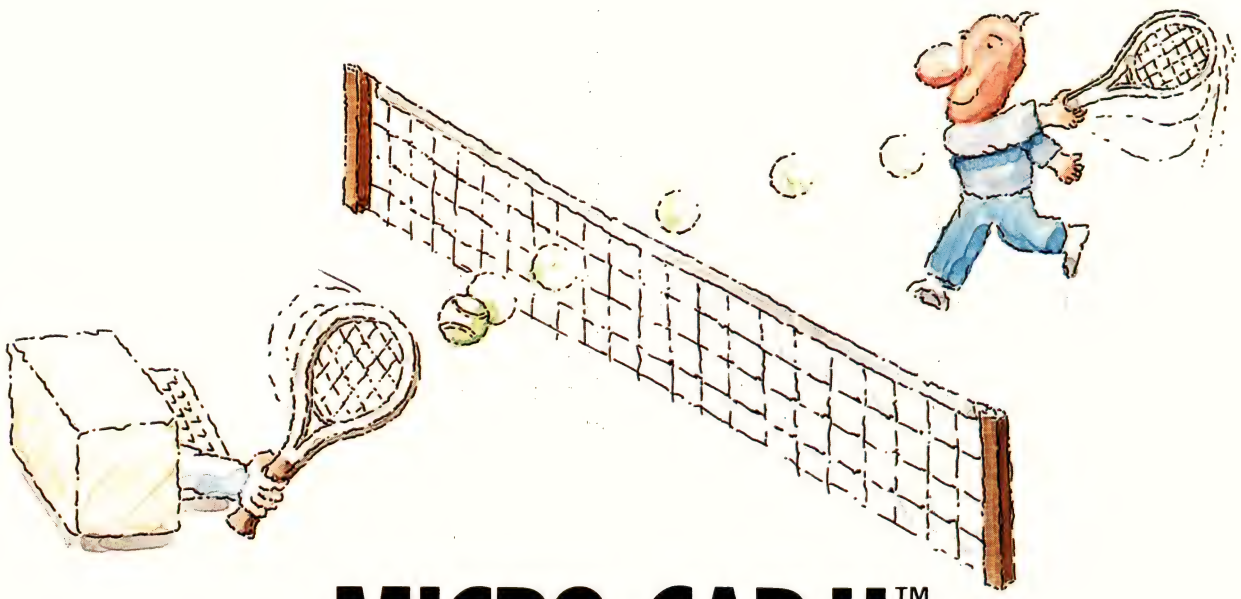
Surface Mount '88, Marlborough, MA. MG Expositions Group, 1050 Commonwealth Ave, Boston, MA 02215. (800) 223-7126; in MA, (617) 232-3976. August 30 to September 1.

Modern Electronic Packaging (seminar), Santa Clara, CA. Technology Seminars, Box 487, Lutherville, MD 21093. (301) 269-4102. September 7 to 9.

International Test Conference, Washington, DC. Doris Thomas, ITC, Box 264, Mount Freedom, NJ 07970. (201) 267-7120. September 12 to 14.

Worst-Case Circuit Analysis (seminar), Boston, MA. Design and Evaluation, 1000 White Horse Rd, Suite 304, Voorhees, NJ 08043. (609) 770-0800. September 12 to 14.

C Programming Workshop (short course), Seattle, WA. SSC, Box 55549, Seattle, WA 98155. (206) 527-3385. September 12 to 15.

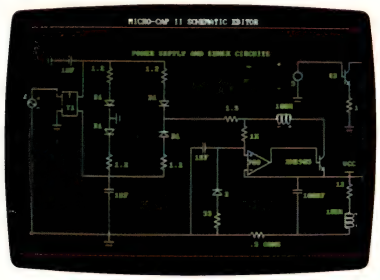


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Spectrum Software's MICRO-CAP II® is fast, powerful, and feature rich. This fully interactive, advanced electronic circuit analysis program helps engineers speed through analog problems right at their own PCs.

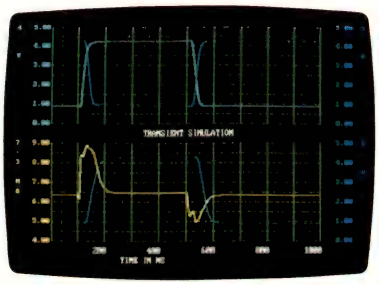
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The program has a sophisticated integrated schematic editor with a pan capability. Just sketch and analyze. You can step



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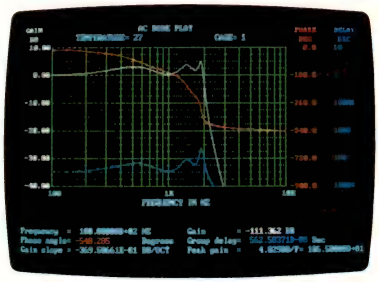
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AC Analysis

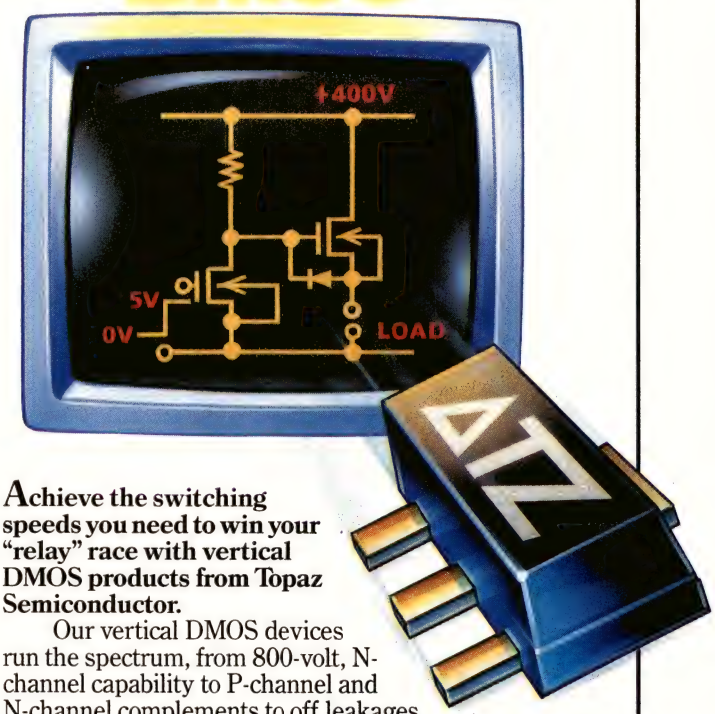
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CIRCLE NO 30

DID YOU KNOW?

EDN is distributed at every major electronics/computer show in the U.S., France, and Germany.

EDN

CALENDAR

12th International Fiber Optic Communications and Local Area Networks Exposition, Atlanta, GA. Information Gatekeepers, 214 Harvard Ave, Boston, MA 02134. (800) 323-1088; in MA, (617) 232-3111. September 12 to 16.

Connector and Interconnection Technology Symposium, Dallas, TX. Electronic Connector Study Group, 104 Wilmot Rd, Suite 201, Deerfield, IL 60015. (312) 940-8800. October 3 to 5.

Autotestcon, Minneapolis, MN. Steve Palmer, Unisys, 3333 Pilot Knob Rd, Eagan, MN 55121. (612) 456-2349. October 4 to 6.

Buscon/88 East, New York, NY. Conference Management Corp, 200 Connecticut Ave, Norwalk, CT 06856. (203) 852-0500. October 4 to 6.

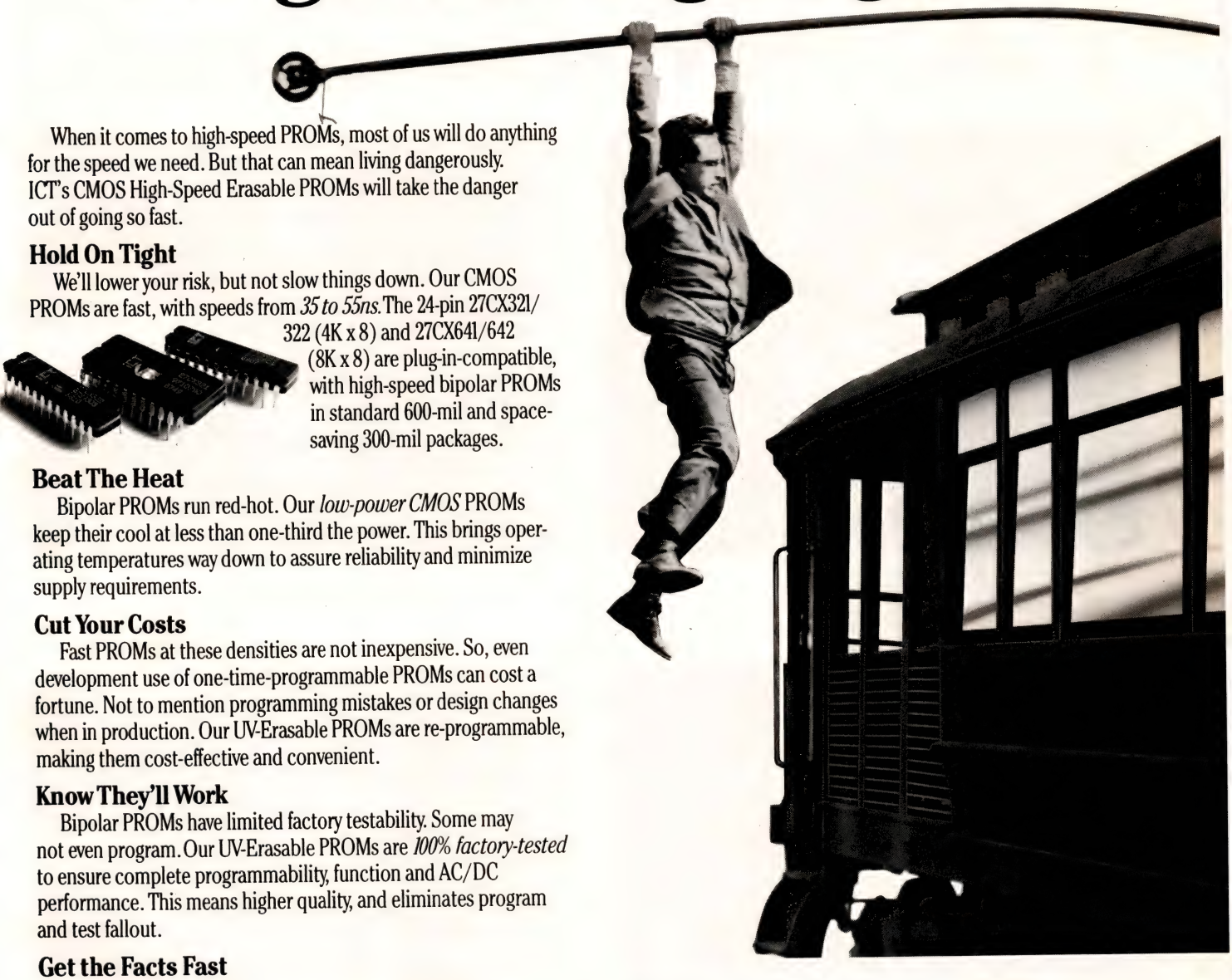
Electronic Imaging Conference East, Boston, MA. MG Expositions Group, 1050 Commonwealth Ave, Boston, MA 02215. (800) 223-7126; in MA, (617) 232-3976. October 4 to 6.

Power Electronics East, New York, NY. Conference Management Corp, 200 Connecticut Ave, Norwalk, CT 06856. (203) 852-0500. October 4 to 6.

Frontiers '88: The 2nd Symposium on the Frontiers of Massively Parallel Computers, Fairfax, VA. Frontiers Symposium, Box 334, Greenbelt, MD 20770. October 10 to 12.

International Electronic Manufacturing Technology (IEMT) Symposium, Lake Buena Vista, FL. Bill Moody, 2529 Eaton Rd, Wilmington, DE 19810. (302) 478-4143. October 10 to 12.

Let our PROMs take the danger out of going fast.



When it comes to high-speed PROMs, most of us will do anything for the speed we need. But that can mean living dangerously. ICT's CMOS High-Speed Erasable PROMs will take the danger out of going so fast.

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We'll lower your risk, but not slow things down. Our CMOS PROMs are fast, with speeds from *35 to 55ns.* The 24-pin 27CX321/322 (4K x 8) and 27CX641/642 (8K x 8) are plug-in-compatible, with high-speed bipolar PROMs in standard 600-mil and space-saving 300-mil packages.

Beat The Heat

Bipolar PROMs run red-hot. Our *low-power CMOS* PROMs keep their cool at less than one-third the power. This brings operating temperatures way down to assure reliability and minimize supply requirements.

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Fast PROMs at these densities are not inexpensive. So, even development use of one-time-programmable PROMs can cost a fortune. Not to mention programming mistakes or design changes when in production. Our UV-Erasable PROMs are re-programmable, making them cost-effective and convenient.

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Bipolar PROMs have limited factory testability. Some may not even program. Our UV-Erasable PROMs are *100% factory-tested* to ensure complete programmability, function and AC/DC performance. This means higher quality, and eliminates program and test fallout.

Get the Facts Fast

If you want to live in the fast lane, be sure to find out how to do it safely. Call us now and we'll send you the risk-free facts on our CMOS High-Speed Erasable PROMs, and information on our Serial EEPROMs and PEEL™ (Programmable Electrically Erasable Logic) devices, too. International CMOS Technology, Inc., 2125 Lundy Avenue, San Jose, CA 95131. **(408) 434-0678.**

All ICT products are exclusively distributed through Marshall Industries.

ICT CMOS High-Speed Erasable PROM Selection Guide

Device	Pins	Package	Organization	Speed (T_{AC})	Power (I_{CC})
27CX321	24	600 mil	4K x 8	35, 40, 45ns	40mA*
27CX322	24	300 mil	4K x 8	35, 40, 45ns	40mA*
27CX641	24	600 mil	8K x 8	40, 45, 55ns	60mA
27CX642	24	300 mil	8K x 8	40, 45, 55ns	60mA

* User-programmable 500 μA low-power standby mode

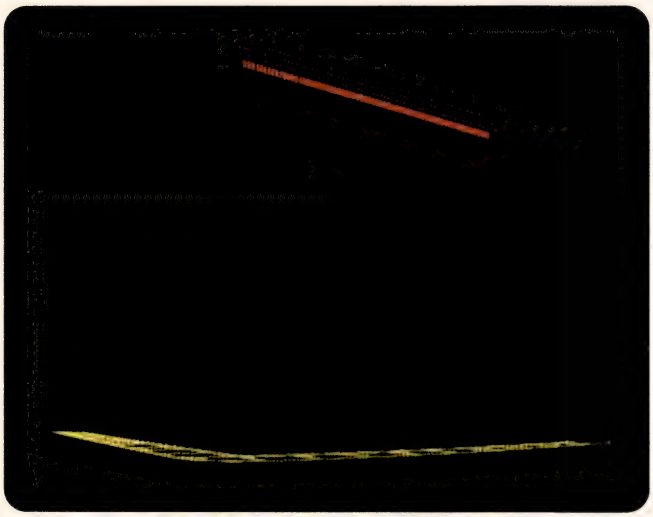
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CIRCLE NO 31

National Semiconductor

In the time it takes other graphics engines to draw a few lines...



Texas Instruments TMS 34010 (2%)



AMD Am95C60 (17%)



Hitachi HD63484 (20%)



Intel 82786 (25%)

GeoCad perspective drawing courtesy of Rudolph Horowitz and Associates, Architects.
Simulated performance based on maximum patterned line-drawing rates in an eight-bit color system with a resolution of 1024 by 768.
Of course, performance ultimately depends on system elements like memory speed.

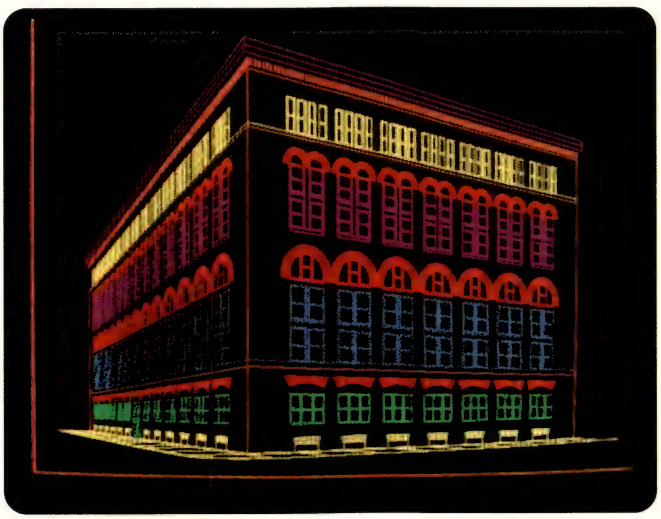
ours gives you the whole picture.

THE FIRST FULLY PROGRAMMABLE GRAPHICS PROCESSOR WITH ON-CHIP ACCELERATION

You can have the fastest calculations in the world but if your system's graphics are slow, your system is slow. National's latest addition to its Advanced Graphics Chip Set—the DP8500 Raster Graphics Processor (RGP)—is the fastest graphics engine on the market.

This 20-Mhz CMOS chip features a bus cycle time of 100 nanoseconds on back-to-back vector and block operations.

It gives you blazing speed in line drawing, BitBLT, fills, polygons, character drawing, and windowing—regardless of the number of bit planes. It also controls screen refresh.



National DP8500 Raster Graphics Processor

COMPLETE FLEXIBILITY

The RGP gives you the programmability of a general-purpose processor, so you can optimize your system for specific applications. Or differentiate it from your competitors through proprietary algorithms.

The RGP, with our DP8511 BitBLT processing unit, is also the only graphics solution that effectively allows you to select either planar- or pixel-oriented operation on-the-fly. So you no longer have to lock yourself into one architecture or the other.

The RGP handles the very highest-resolution CRTs and printers, including laser printers. And it supports any type of memory.

It also gives you the right "hooks" and the right architecture for moving into 3D and solids modeling applications.

A COMPLETE SET OF CHIPS

Our Advanced Graphics Chip Set also includes

- two BitBLT processing units
- four video clock generators
- four video shift registers
- three video RAM controllers
- a growing list of video DACs

They're all part of National's unique modular approach—the only approach that addresses the complete graphics pipeline. And the only one with the performance and flexibility you need to carry you into the 1990s.

COMPLETE SUPPORT

We offer a wide range of software tools—including assembler, debugger, librarian, linker, software utilities, graphics kernel packages, and a C compiler package.

Nova Graphics International is providing full support for graphics software standards, including GKS and CGI.

Check it all out for yourself with the DP850EB demo/evaluation board for only $1495. Buy the board and we'll include a coupon good for ten free RGPs on your first order of 100 or more.

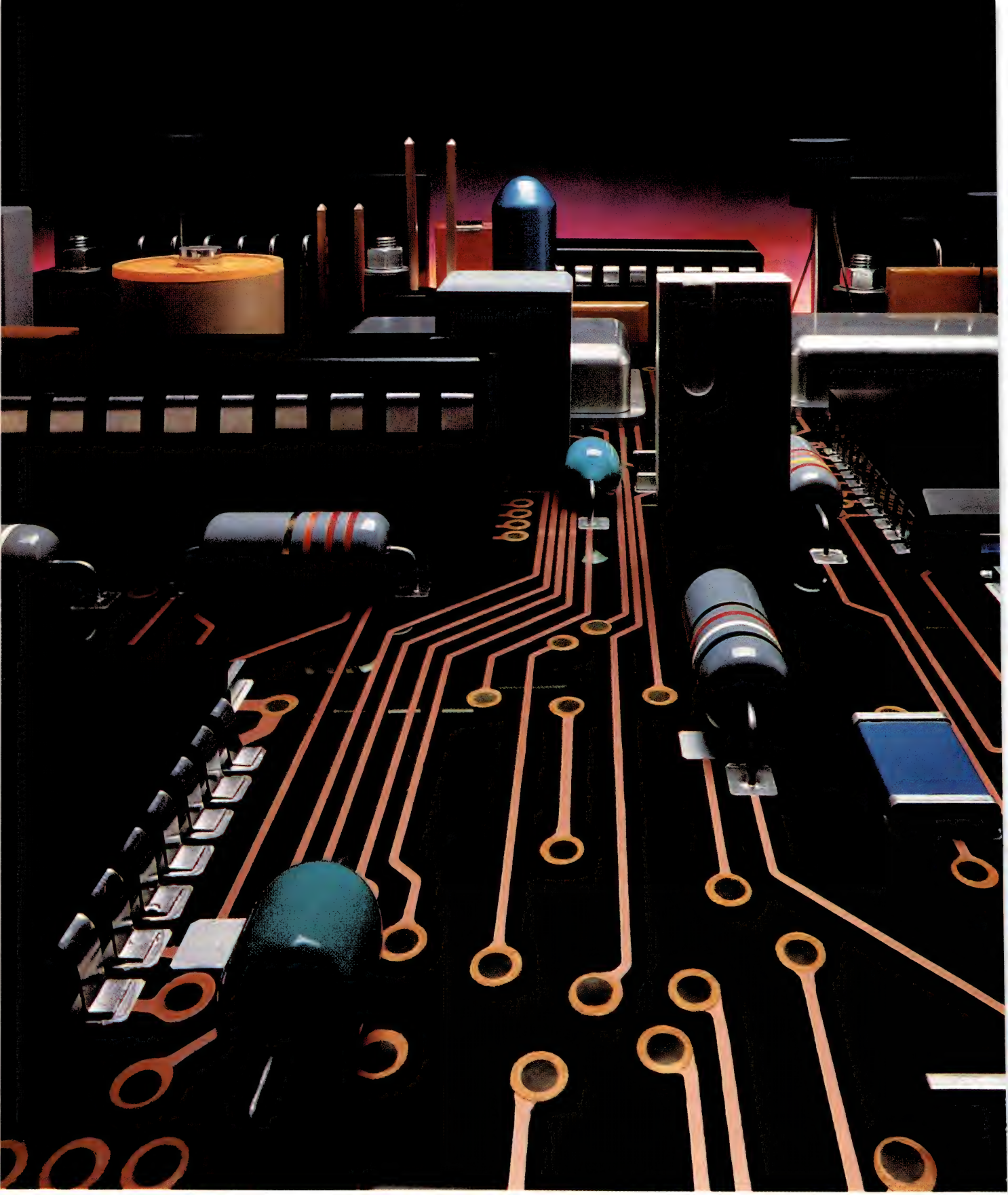
To order today, call National Semiconductor at (408) 721-5404. Or for a copy of our system-level comparison brochure, circle the reader service number.

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Advanced Peripherals

CIRCLE NO 32





If you want to increase the value of your PWB real estate, Du Pont can help you do it.

With VACREL® photopolymer film solder mask. The material that enables you to reliably encapsulate dense circuitry and tent via holes, permitting more electrical functions in less PWB real estate; to let you create higher density PWBs than ever before.

Instead of placing vias and components on separate areas of the board, you simply design vias under the components. And because VACREL tents the vias, solder stays only in the places where you want it; you avoid bridging, shorts, and contamination. It's also easier to clean under components.

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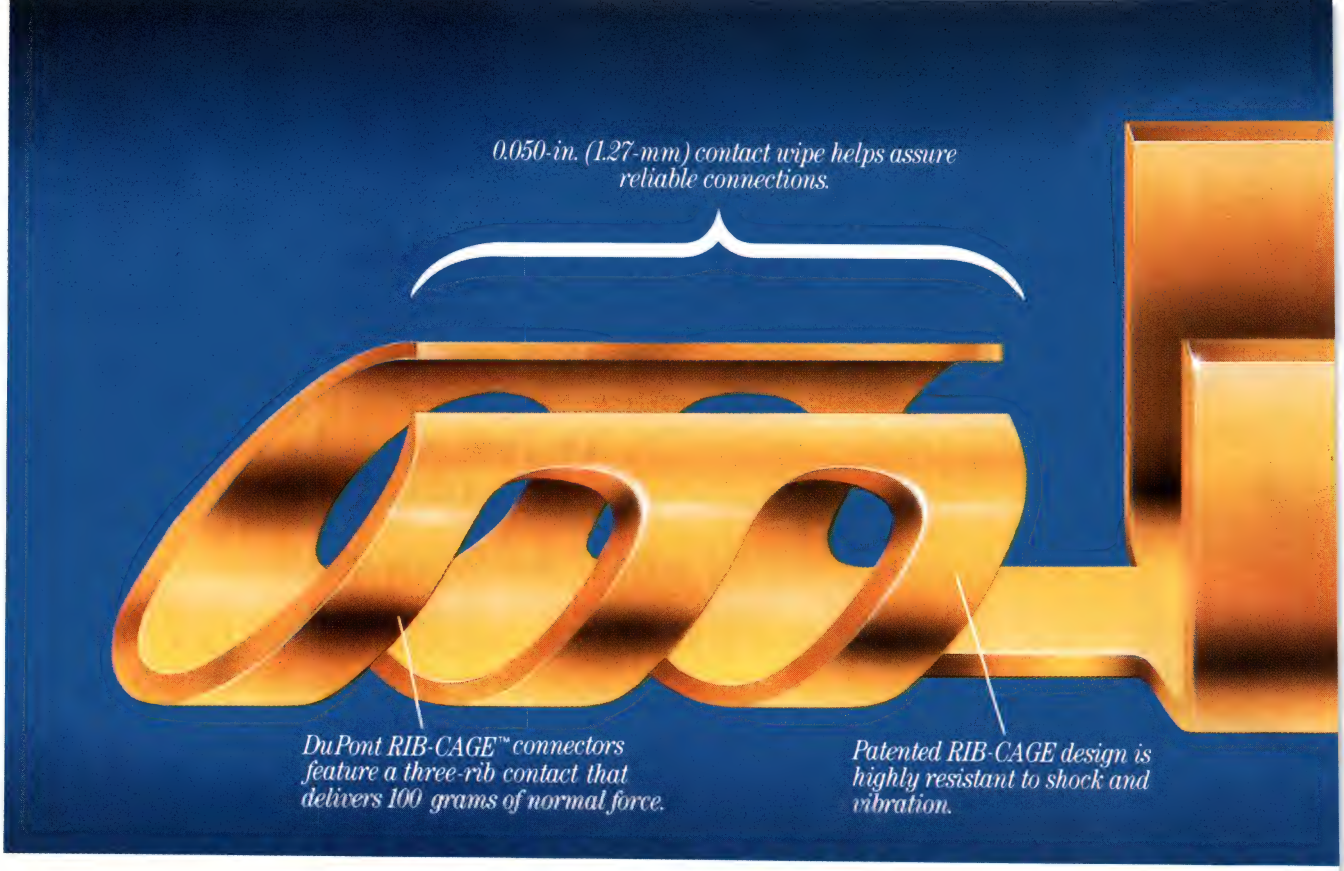
If you want more value out of your PWB real estate, ask for VACREL photopolymer film solder mask. It's the right material for PWB designs. Just call Du Pont at **1-800-237-4357.** Or write: Du Pont Company, Room G-51176, Wilmington, DE 19898.

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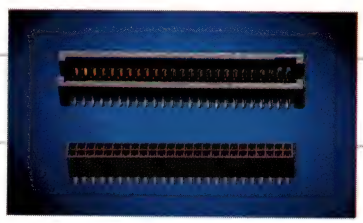


Big Performance. Little Package.

Rib-Cage connectors deliver 100-gram normal force in miniature/microminiature interconnectors.

Du Pont's RIB-CAGE™ design lets you pack 0.100-in. centerline performance into 0.050-in. c/l packages.

Our patented angled-rib design creates a contact area large enough to produce a normal force of 100 grams, with remarkably high shock and vibration resistance.

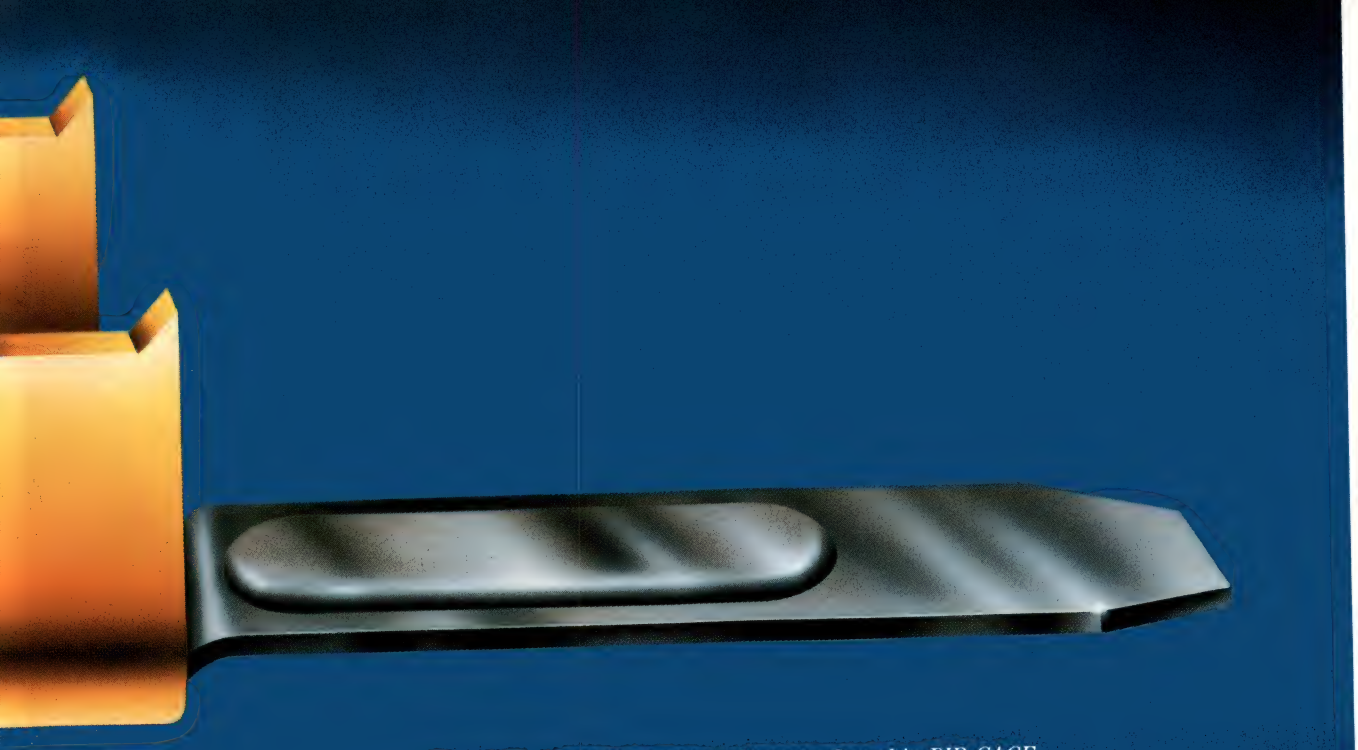


Actual size of 50-position 0.050-in. (1.27-mm) vertical surface-mount RIB-CAGE card connector and mating male header.

And the long contact wipe helps assure reliable connections through repeated cycles.

You get inductance, capacitance and impedance values that are compatible with faster signal speeds (thanks to the 0.050 in. design), along with high current capacity and low circuit resistance.

In addition, RIB-CAGE connectors let



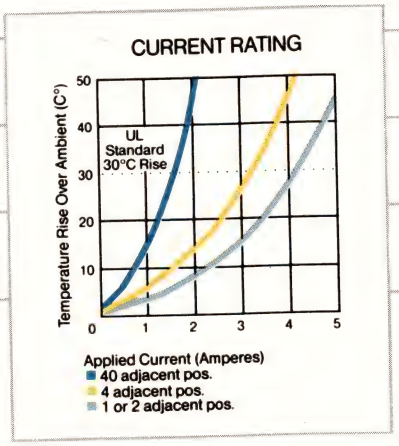
Shown above: 60X illustration of terminal used in RIB-CAGE connectors. Actual length is 0.250 in.

you increase surface density, since they take up only one-eighth the volume of 0.100-in. centerline connectors, while delivering profiles as low as 0.18 in. for special applications.

Whether you're working with through-mount or surface-mount technology, single or dual-entry designs, we have a RIB-CAGE design that can work for you.

Let us show you how to get big performance from a little package.

For a free sample kit of RIB-CAGE connectors, just call **1-800-237-4357** (in Pennsylvania, call 1-800-222-2194). Or write: Du Pont Company, Room G51117, Wilmington, DE 19898.



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CIRCLE NO 34



The tape on the left will change the way you look at multilayer circuitry. So will the one on the right.

Introducing the Green Tape System* from DuPont. And a free videotape that shows what this new multilayer circuit technology can do for you.

Green Tape is a low-temperature, co-fireable ceramic based system that combines the design flexibility of thick film systems with the manufacturing ease of co-fired alumina systems.

Green Tape eliminates the multiple firing steps required with traditional thick film technology. And unlike co-fired alumina, where extreme firing temperatures destroy high conductivity metals such as gold and silver, the Green Tape System is perfectly compatible with precious metal circuitry.

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If you think the Green Tape System sounds good, wait'll you see how it can help you improve your multilayer circuitry. Call for your free videotape: **1-800-341-4004.**

*DuPont's trademark for dielectric tape, inner layer and via fill conductors.

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CIRCLE NO 35

Fewer hypocrites, please



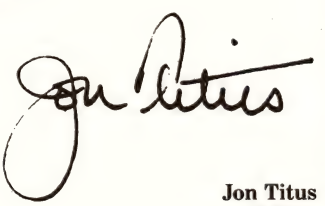
Although discussion about engineers' overtime work has continued for years, the recent reports of $7-per-hour engineers reawakened many to "wage busting" practices. Wage busting occurs when a company pays an engineer a salary but also requires the engineer to put in overtime—without additional pay. Thus, when you average the engineer's real pay over the actual time worked, the wages are "busted." Businesses frequently offer the US government low bids on contracts by depending on such mandatory uncompensated overtime.

As we've noted previously, the IEEE has been pressing the case against all types of wage busting, including mandatory uncompensated overtime embodied in defense contracts. The IEEE reports that legislation before the Senate and the House of Representatives will, when passed, curb the practice. According to the IEEE, the House Armed Services Committee recently directed the Department of Defense to assess contractor bids on the basis of a 40-hour work week. Hourly wages will be based on the same 40-hour week.

The House report states, "Allowing companies to require mandatory uncompensated overtime in order to reduce its price does not provide the best value for the dollar in the long run. In addition, allowing companies to bid on that basis is in effect sanctioning practices that undermine the government's effort to obtain quality professional services."

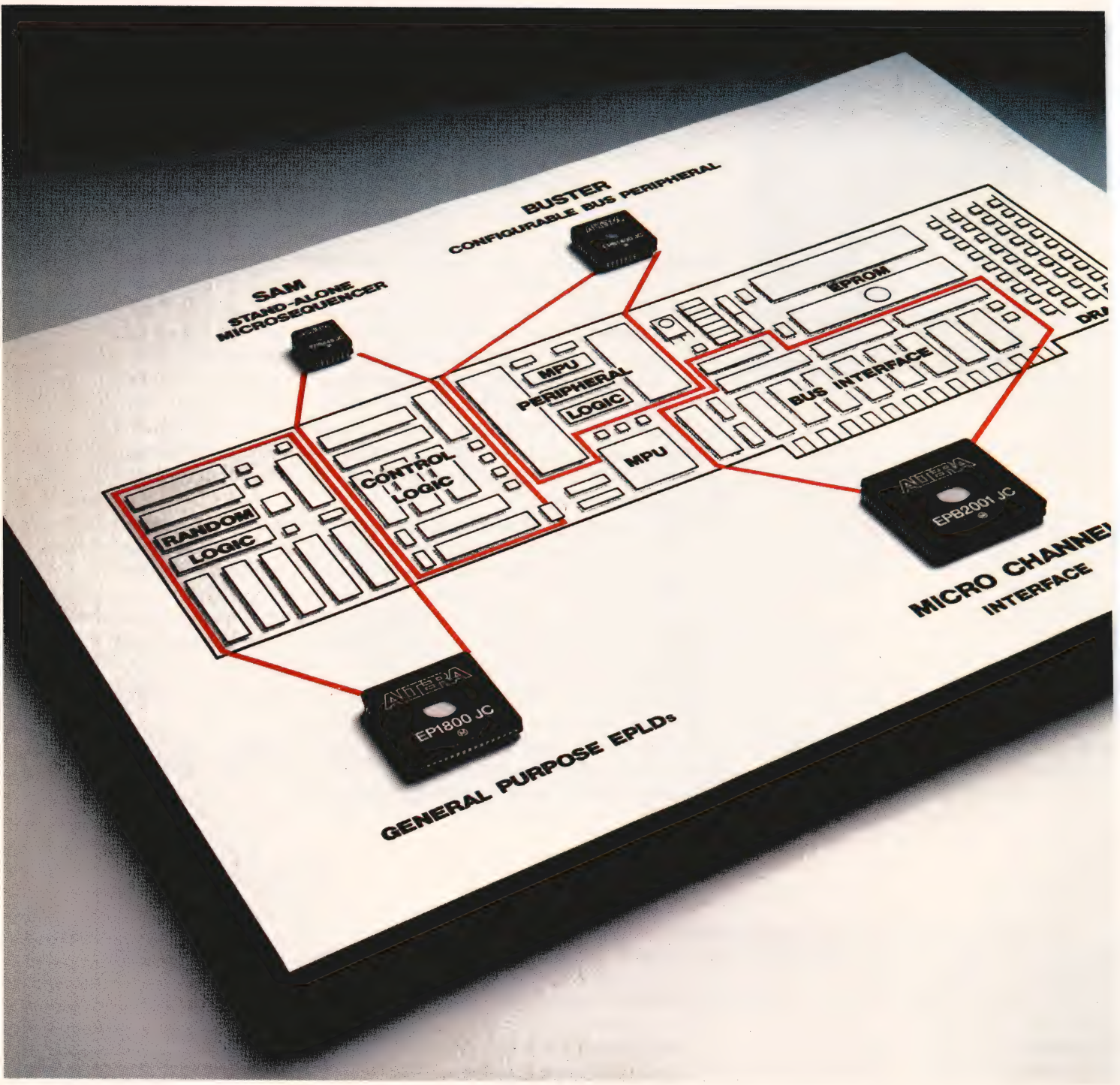
Unfortunately, it's difficult to take Congress's overtime concerns seriously. Congress exempts itself from the Fair Labor Practices Act, and other labor laws, so it doesn't have to abide by overtime legislation—and it often doesn't. According to the *Wall Street Journal*, workers in the House Folding Room have had to work 70-hour weeks without overtime pay. And congressional employees shouldn't complain to the press, either, reports the *Journal*, because Congress exempts itself from the civil-service regulations that protect other government whistleblowers.

Certainly, overtime is an important issue for engineers—as is good, nonhypocritical government. That's something to keep in mind as we enter the fall campaign season.



Jon Titus
Editor

After 4 years of we're announcing



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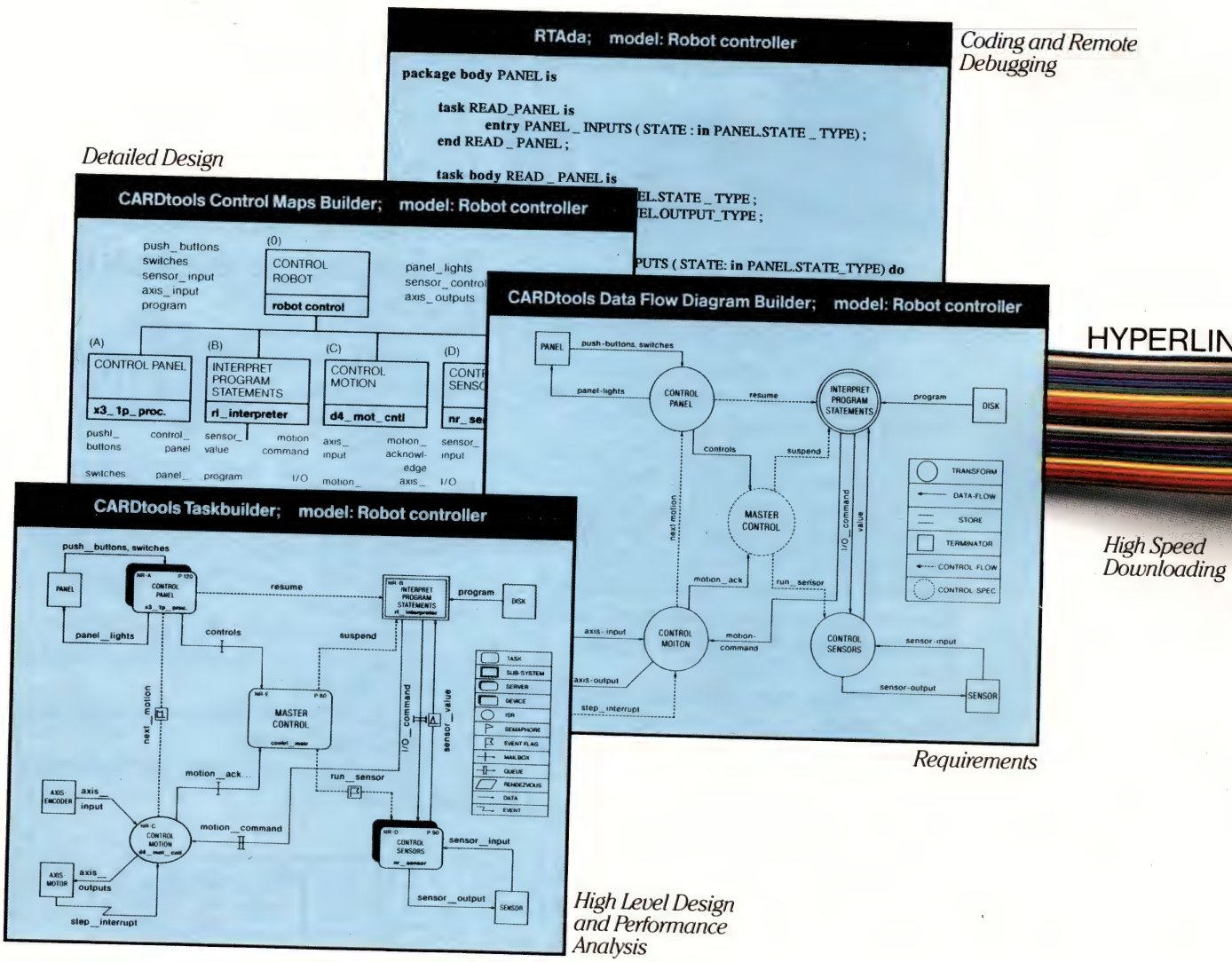
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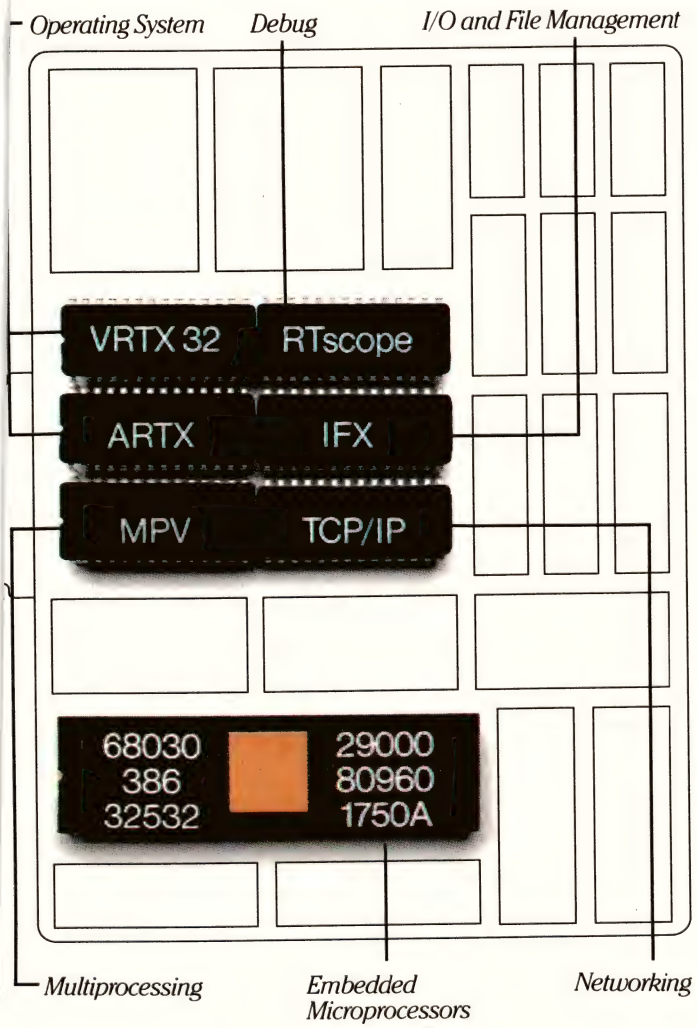
CIRCLE NO 36

Do you have to design in



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To find out more about the Fluke 90 Series, or the products that made Fluke the leader in emulative board testing, the 9000 Micro-System Troubleshooter or 9100 Digital Test System, call today at:

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For countries not listed, write to Philips I&E, T&M Department, Building HKF, 5600 MD Eindhoven, The Netherlands.

PHILIPS

PHILIPS

X.25 serial communications controller connects factory floor to packet networks

Designed to link remote factory sites, the GESSCC-1 serial communications controller implements the first three layers of the 1984 CCITT X.25 LAPB (link access protocol balanced) data-link procedure. An onboard Motorola 68605 X.25 protocol controller IC implements the first two layers, the physical and data-link layers. Executing onboard firmware, a 68010 implements level 3, the network layer. Systems using the controller can communicate with remote systems via a leased line or a packet-switching network, and eventually, via ISDN.

The intelligent G-64 bus board can support serial data transfer rates as high as 10M bps. It includes a 68010 μP that runs at 12.5 MHz and features 512k bytes of RAM and two 32-pin sockets that can provide as much as 256k bytes of EPROM. The Gesint-3, an external interface module, adapts onboard X.25 TTL-level serial signals to RS-232C, RS-422, or RS-485 signals. The board also provides two auxiliary RS-232C ports, a programmable bit-rate generator, and a 16-bit timer.

The GESSCC-1's multitasking executive in firmware allows you to customize the controller for specific applications. It targets, in particular, applications that require the transfer of real-time industrial-manufacturing data and process-control data between remote sites. The single-height Eurocard form and DIN connector make the board suitable for such factory applications.

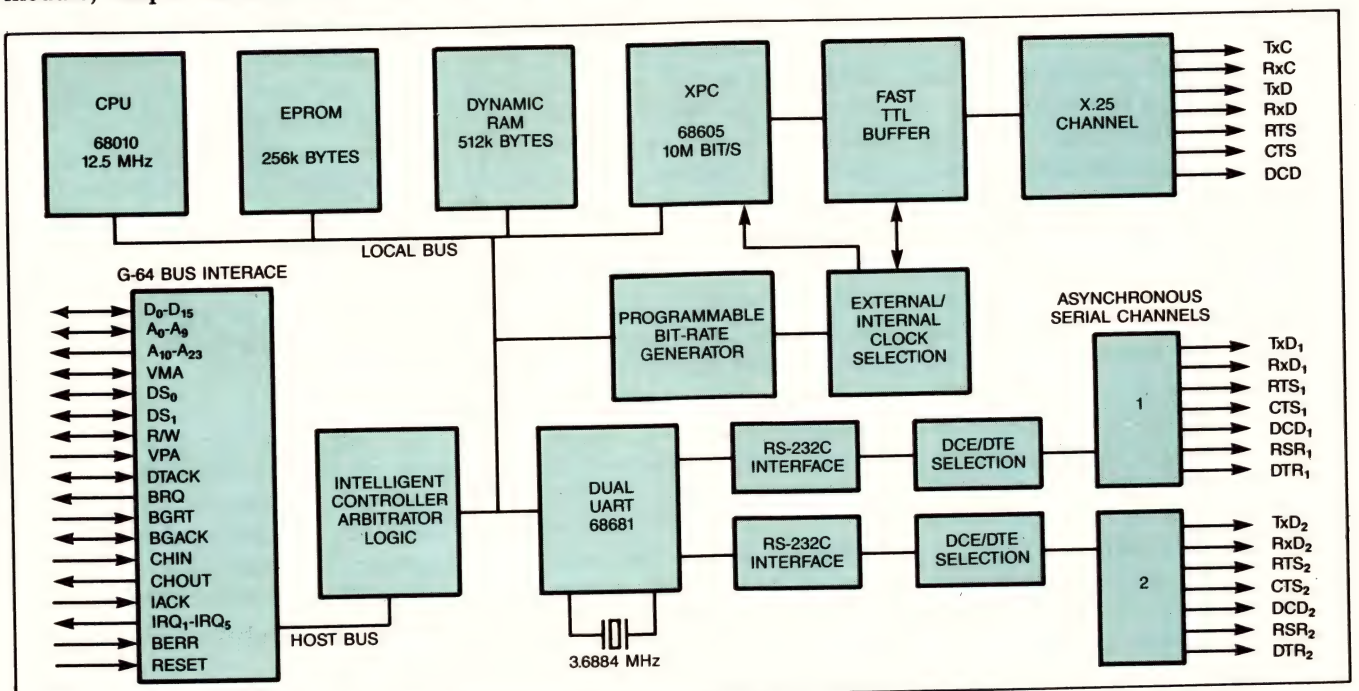
The firmware also allows you to use the board as a PAD (packet assembler/disassembler). A PAD typically connects the user's terminal to a public data network. The GESSCC-1 can act as a PAD between its two onboard RS-232C ports and the X.25 interface. The controller's PAD implementation complies with the X.3, X.28, and X.29 protocols.

Typically, the controller board will allow you to interface systems with packet-switching networks such as Telenet and Tymnet. Although the board can support serial transfers as high as 10M bps, most public data networks operate at a maximum speed of 2M bps. For higher-speed operations, the controller can connect systems directly or to a leased line.

The GESSCC-1 controller board supports vectored and nonvectored interrupts, and communicates with the host CPU via 16-bit DMA transfers. It can handle data-packet sizes as large as 4096 bytes and costs $1695 (100).—***Maury Wright***

Gespac Inc, 50 W Hoover Ave, Mesa, AZ 85210. Phone (800) 443-7722; in AZ, (602) 962-5559.

Circle No 462



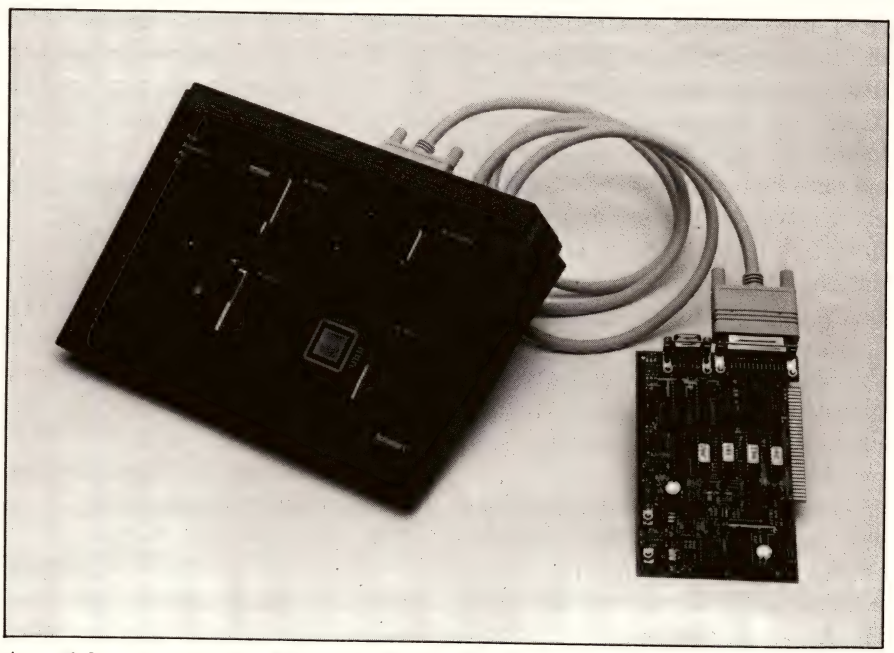
The GESSCC-1 is a G-64 bus board *that links remote factory sites and provides 10M-bit/sec serial communications. The 68605 implements the physical and data-link layers (layers 1 and 2), and the 68010 implements the network layer (layer 3) of the 1984 CCITT X.25 LAPB protocol.*

One-time programmable gate arrays offer quick turnaround times

Gate-array users continue to long for devices that offer short turnaround times and low prototyping costs. Typically, users want prototypes in less than a week and samples that cost less than $1000 to produce. Although these demands seem almost impossible to satisfy, you can now actually buy a desk-top gate-array development system and one-time-programmable (OTP) devices that do it all.

The ACT1 series features two programmable gate-array devices: the ACT1010, which has 1200 gates that are equivalent to the gates in standard gate arrays, and the ACT1020, which has 2000 of those gates. Both devices implement the manufacturer's antifuse technology. Given the trade name Plice (programmable low-impedance circuit element), the antifuse technique links conductive runs within the chip. Most module-to-module connections require two or three antifuse links. Once programmed, the Plice connections are permanent.

The chips' basic logic building block is a configurable logic module. The module is similar to a conventional gate-array logic element in that you can configure it into various logic functions. The manufacturer provides a macro library that contains over 200 standard logic functions, such as counters, gates, flip flops, and arithmetic elements. Unlike other gate-array products, the ACT1 family provides no fixed flip-flop devices on its chips. Users configure their own flip flops by selecting the appropriate macro from the library. The 1200-gate device offers 295 logic modules that let you configure as many as 147 J-K flip flops. Similarly, the 2000-gate chip lets you produce as many as 275 J-K flip flops.



A special programming and diagnostic fixture *lets you program and test gate-array chips that use the manufacturer's antifuse technology. The unit plugs into an 80386-based computer or workstation.*

These 2 gate-array chips use a 2-micron double-metal CMOS process that creates flip flops that run at toggle rates as high as 70 MHz. That speed translates into a 40-MHz system clock frequency. The ACT1010 has 57 I/O elements; the ACT1020 has 69. Each output is TTL compatible and supplies a 4-mA drive current.

To use the ACT1 chips, you need the Action Logic System, which costs $19,950. The system includes a complete suite of standard software for schematic capture, timing analysis, and electrical-rules checking. A proprietary routing algorithm provides fully automatic placement and routing for designs that use a maximum of 85 to 95% of the chips' modules. The software often fully places and routes designs that use all of a chip's modules.

The development system also includes a programming and testing fixture that plugs into an 80386-based computer or workstation. Programming takes about 15 minutes per device. The system's diagnostic software lets you probe any two of the chips' internal logic connections during testing. The probe points aren't fixed: Software commands let you move the connections from signal to signal within the circuit. You can also purchase an add-on simulation software package for an additional $4500.

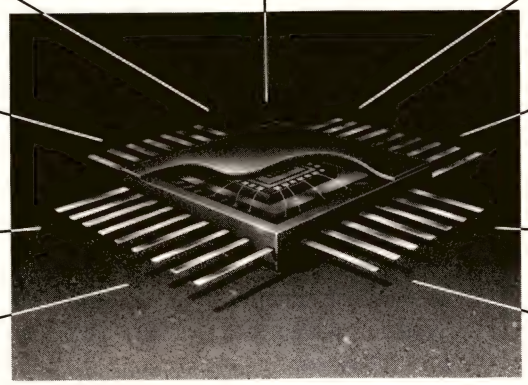
The ACT1010 chip costs $70, and the ACT1020 chip costs $115 (10-99). The chips come packaged in 84-pin ceramic chip carriers. The ACT1010 is available now; samples of the ACT1020 will be available in September. The manufacturer plans to offer 1.2-μm devices with 3000- and 6000-gate densities in 1989.

—Jon Titus

Actel Corp, 320 Soquel Way, Sunnyvale, CA 94086. Phone (408) 732-2835. TLX 62957251.

Circle No 460

SONY'S ECL LOGIC HAS THE GUTS TO CHALLENGE GaAs PERFORMANCE.



When you need high-speed logic, it really pays to look into Sony's ECL logic family.

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Part Number	Function	tpd	fmax	Power	Package
CXB1100Q	Quad 3-in OR/NOR	390 ps	1.5 GHz	530 mW	24 FLAT
CXB1101Q	Quad 3-in AND/NAND	470 ps	1.5 GHz	700 mW	24 FLAT
CXB1102Q	Quad 2-in EXOR/NOR	490 ps	1.5 GHz	680 mW	24 FLAT
CXB1103Q	Quint Line Receiver	410 ps	1.5 GHz	650 mW	24 FLAT
CXB1104Q	Dual D Flip Flop	620 ps	3.2 GHz	520 mW	24 FLAT
CXB1105Q	Triple Fan-out Buffer	590 ps	1.5 GHz	720 mW	24 FLAT
CXB1106Q	4-Stage Ripple Counter		3.4 GHz	720 mW	24 FLAT
CXB1107Q	Decision Circuit		3.2 GHz	430 mW	24 FLAT
CXB1108Q	Laser Driver		2.0 GHz	740 mW	16 FLAT
CXB1109Q	Quad D-FF with Master Reset	620 ps	3.4 GHz	790 mW	24 FLAT
CXB1110Q	16 to 1 Multiplexer	610 ps	1.5 GHz	680 mW	24 FLAT
CXB1111Q	Look Ahead Carry Block	580 ps	1.5 GHz	610 mW	24 FLAT
CXB1112Q	Phase Frequency Detector	720 ps	0.8 GHz	500 mW	24 FLAT
CXB1113Q	4 to 1 Multiplexer		2.0 GHz	950 mW	24 FLAT
CXB1114Q	1 to 4 Demultiplexer		2.5 GHz	1100 mW	24 FLAT
CXB1130Q	9, 8, 4-bit Multiplexer		1.6 GHz	730 mW	32 FLAT
CXB1131Q	9, 8, 4-bit Demultiplexer		1.6 GHz	1000 mW	32 FLAT
CXB1132Q	9, 8, 4-bit Universal Shift Register		1.3 GHz	910 mW	32 FLAT
CXB1133Q	22, 15, 7-Stage Scrambler		1.6 GHz	600 mW	24 FLAT
CXB1134Q	22, 15, 7-Stage Descrambler		1.6 GHz	610 mW	24 FLAT
CXB1135Q	8-16 bit Comparator		1.3 GHz	630 mW	32 FLAT
CXB1136Q	8-bit Universal Counter		1.2 GHz	730 mW	32 FLAT
CXB1137Q	8-bit Shift Matrix	1250 ps		700 mW	24 FLAT
CXB1138Q	4-bit Arithmetic Logic Unit	1460 ps		680 mW	24 FLAT

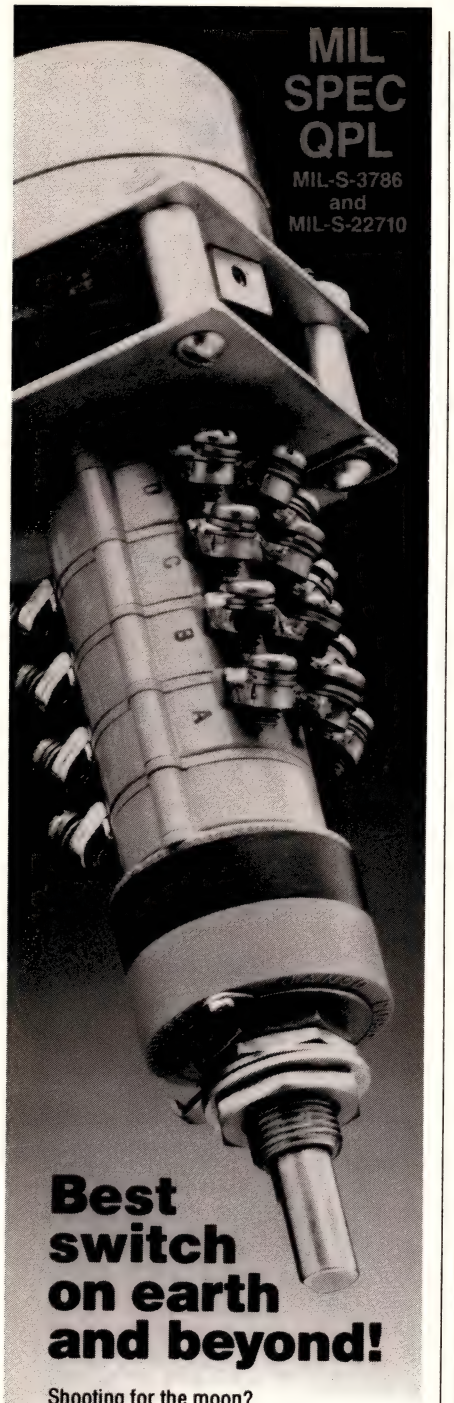
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CIRCLE NO 40

Compact power supply fits 130W into less than 40 in^3

If your system design requires a supply that squeezes a lot of power into a small space, consider using the RP-130/4 switching power supply, which packs as much as 130W into less than 40 in^3. The 6.1×3.95×1.6-in. supply operates from line power; you can configure it to operate from 95 to 132V ac or 190 to 264V ac from 47 to 440 Hz. At the nominal 110/220V, the unit can supply 130W of power continuously, and can generate as much as 150W for short periods.

The RP-130/4 provides you with four dc outputs: 5V at 12A, 12V at 8A, −12V at 1A, and −5V at 1A. All of the positive outputs have 1% line and load regulation; for the negative outputs, that spec is 3%.

The unit switches sinusoidal currents at the zero-crossing point by using a series-resonant configuration operating at 250 kHz. The result is low EMI—the supply meets FCC and VDE class B EMI levels for conducted noise without external filtering—and a calculated MTBF of 80,000 hours. The high switching speed provides fast transient response. The unit returns to within 1% of final value in 500 μsec following a 25% load step.

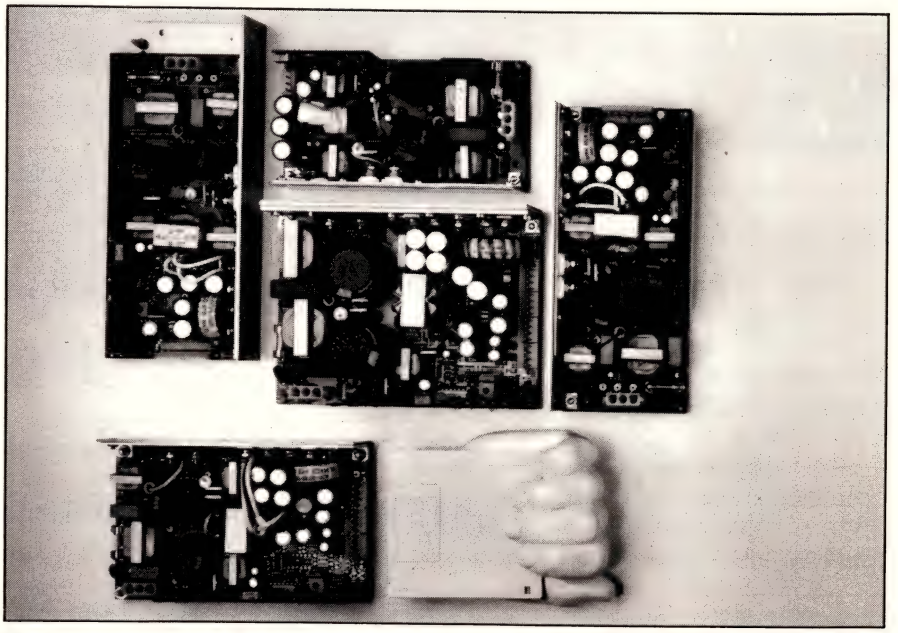
A by-product of the supply's topology is the unit's output-noise characteristics: The output voltages have 100 mV p-p noise in the 50 Hz to 20 MHz range. Below 1 MHz, the noise is only 50 mV p-p.

The unit is specified for storage over −25 to +75°C. You can obtain the full rated power output at an ambient temperature of 40°C if you provide forced-air cooling of at least 200 linear feet per minute. In free-air conditions at 40°C, you should derate the power output to 80W. The supply costs $140 (250).

—Richard A Quinnell

Resonant Power Technology Inc, 3350 Scott Blvd, Building 60/01, Santa Clara, CA 95051. Phone (408) 982-0200.

Circle No 461



***The latest member of this series of compact power supplies** is the RP-130/4, a 4-output, 130W switching supply that measures 6.1×3.95×1.6 in.*

TEXAS INSTRUMENTS REPORTS ON

MEMORY MANAGEMENT

IN THE ERA OF

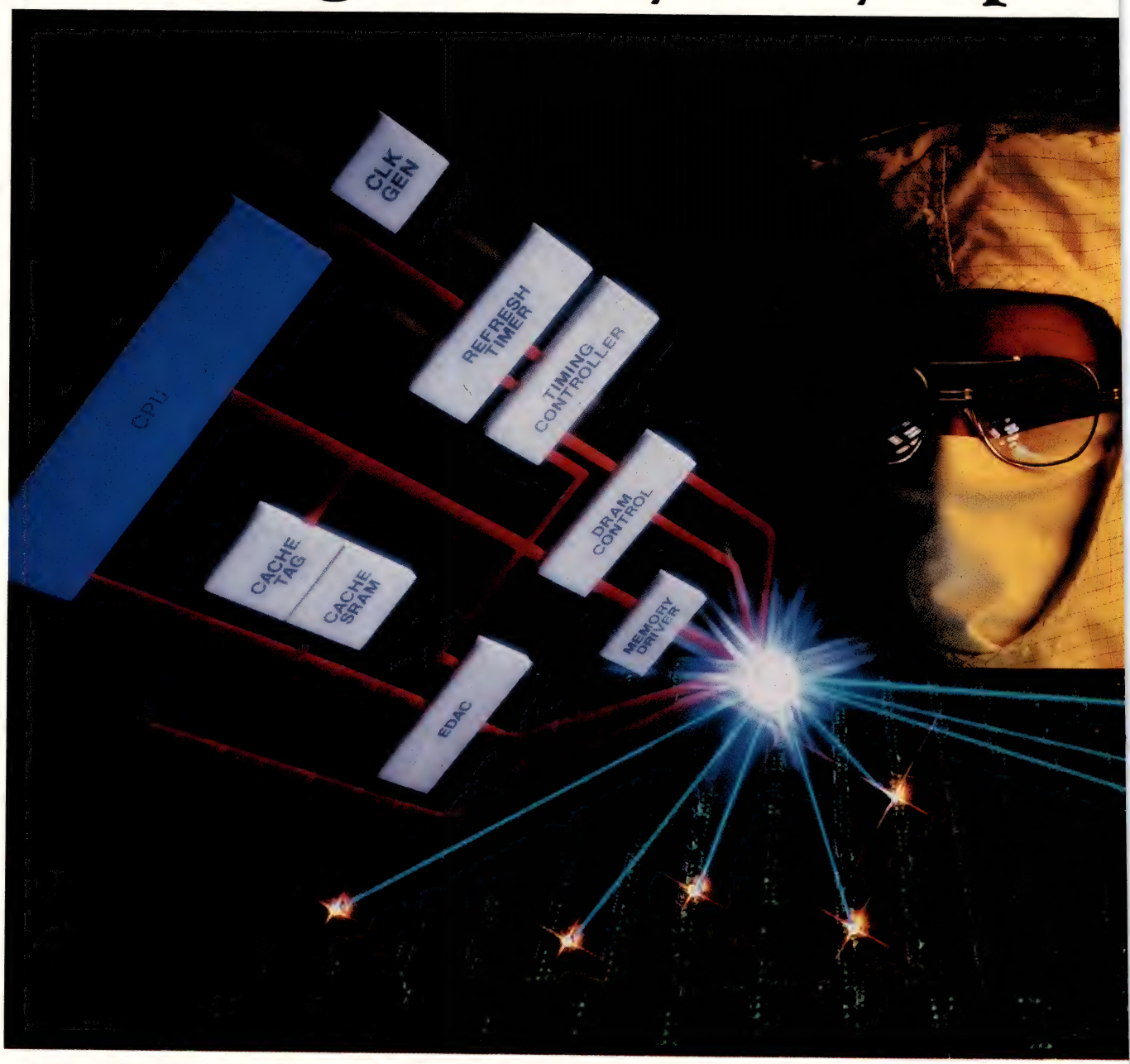
MegaChip TECHNOLOGIES



CIRCLE NO 41

Memory management in the Era of MegaChip Technologies:

Memory-management ICs from you bring memory arrays up to



Memory systems are a prime area for significant improvements in overall system throughput. Read how TI's memory-management ICs can get you in and out of memory faster no matter which processor you choose.

You can now solve a problem whose solution has eluded design engineers for years: How to catch memory speeds up to CPU speeds. The solution lies with TI's advanced memory-management circuits, and you can use them with whichever processor best suits your application.

Texas Instruments can help processor speeds.



A universal architecture enables these TI devices to work with — and enhance — virtually any high-speed microprocessor or bus structure, even custom engines.

In addition, your component count is cut because these are single-chip VLSI circuits. Your design time and effort are shorter and easier because of TI's comprehensive Memory Management Design Kit *(see page 4)*.

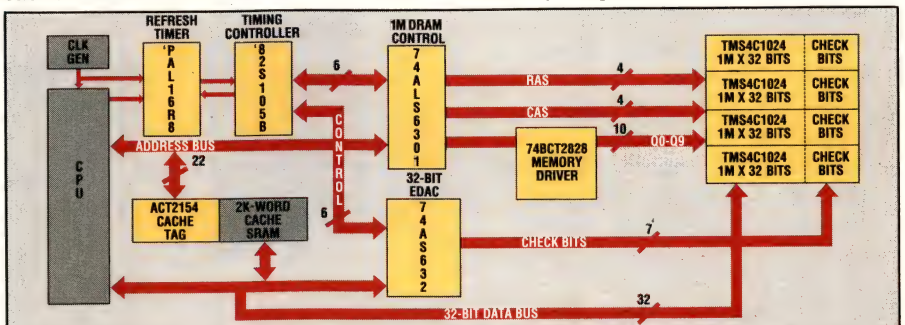
TI addresses your major memory-design concerns

To immediately improve memory-access time, use both main and cache memories, as shown in the block diagram. This approach can produce up to a 3X increase in system performance.

Frequently accessed data and instructions are stored in a few high-speed static random-access memories and "tagged" by a TI industry-standard cache controller (SN74ACT2151/4). These 2K×8 CMOS controllers are the fastest available and can support deep cache architectures of 16K or even 32K.

TI's MegaChip Technologies

Our emphasis on volume manufacturing of high-density circuits is the catalyst for ongoing advances in how we design, process, and manufacture semiconductors and in how we serve our customers. These are our MegaChip™ Technologies. They are the means by which we can help you and your company get to market faster with better, more competitive products.



High-speed memories can be designed with less effort and implemented more cost-effectively by using TI's family of universal memory-management ICs. These devices, all of which are contained in TI's Memory Management Design Kit, will work with and enhance almost any high-speed processor.

This scheme is cost-effective because slower, less expensive dynamic random-access memories (DRAMs) can be used for main memory.

When you must assure system integrity, use of an error-detection-and-correction (EDAC) circuit can improve system reliability 500-fold. Since this approach is necessary with memory arrays larger than half a million bits, TI offers its leadership 32-bit EDAC.

The SN74AS632 detects dual-bit errors and detects and corrects single-bit errors while avoiding processor wait states. And at 25 ns for error detection, it meets your high-performance needs.

Interfacing between processor and main memory gets tougher as speeds increase. But TI has the SN74ALS6301 DRAM timing controller. It can handle any DRAM up to 1 Mbit and incorporates only the essential functions on chip to improve flexibility and speed and to allow for custom timing routines. This controller supports nibble- and page-mode access and scrubbing-mode refresh to increase memory output.

Soon to come: An ASIC (application-specific integrated circuit) solution.

Reducing over/undershoot is accomplished by TI's 2000 Series buffers and drivers — 25-ohm series-damping resistors on the output prevent false reads at DRAM input. For example, the SN74BCT2828 driver can reduce undershoot by 40% compared to traditional approaches. TI's 2000 Series has a high-drive current suitable for VME and MULTIBUS® II bus structures.

You can use any or all of TI's memory-management ICs to obtain the superior performance that marks a market winner. And there's no design rule that says your memory-management chips and your CPU have to come from the same supplier.

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CIRCLE NO 42

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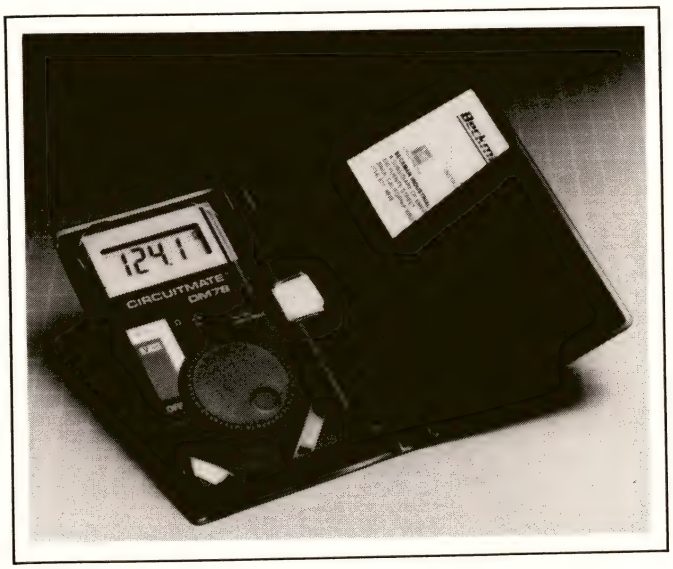
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TEXAS INSTRUMENTS

READERS' CHOICE

Of all the new products covered in EDN's **April 28, 1988,** issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, find out what makes them special: Just circle the appropriate numbers on the Information Retrieval Service card, refer to the indicated pages in our **April 28, 1988,** issue, or use EDN's Express Request service.

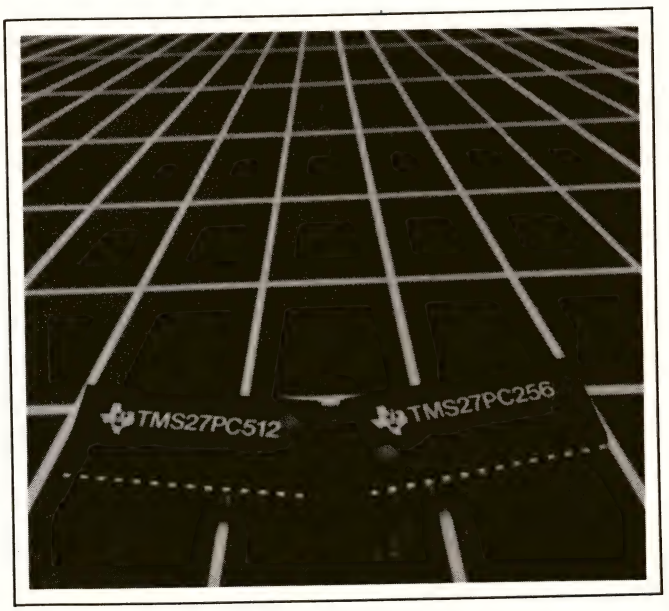


◀ MINIATURE DMM

The Circuitmate DM78 credit-card-size 3½-digit autoranging DMM features readings that range from 200 mV to 400V dc, 2 to 400V ac, and 200Ω to 20 MΩ (pg 314).
Beckman Industrial Corp.
Circle No 605

CMOS PROMs ▶

The TMS27PC64, -27PC128, -27PC256, and -27PC512 CMOS PROMs feature high-speed performance comparable to NMOS devices and provide the added benefits of lower power dissipation and improved reliability (pg 297).
Texas Instruments.
Circle No 603



CASE TOOLS

The C Documenter and C Scan utilities for the IBM PC and compatibles ease the task of documenting and examining programs written in the C programming language (pg 308).
Real Time Systems Ltd.
Circle No 604

PLCC TEST CLIPS

The vendor's plastic leaded-chip-carrier (PLCC) test clips are now available in 28- and 44-pin sizes (pg 290).
3M.
Circle No 602

DSP BOARD

The DSPeed digital signal-processing board for the IBM PC contains an AT&T WE DSP32 floating-point processor, 64k bytes of RAM, and buffered serial I/O ports (pg 249).
Burr-Brown Corp.
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CIRCLE NO 45

LEADTIME INDEX

ITEM	Off the shelf	1-5 weeks	6-10 weeks	11-20 weeks	21-30 weeks	Over 30 weeks	Average (weeks)	Last month's average (weeks)
TRANSFORMERS								
Toroidal	0	13	53	27	7	0	10.6	9.6
Pot-Core	0	7	40	46	7	0	12.5	8.8
Laminate (power)	0	15	40	35	10	0	11.7	8.3
CONNECTORS								
Military panel	0	23	15	62	0	0	11.5	6.0
Flat/Cable	9	45	32	14	0	0	5.7	9.3
Multi-pin circular	0	31	38	25	6	0	9.2	9.3
PC (2-piece)	6	28	55	11	0	0	6.7	5.2
RF/Coaxial	14	27	27	32	0	0	7.8	4.2
Socket	4	35	48	13	0	0	6.6	3.5
Terminal blocks	14	54	27	5	0	0	4.0	4.4
Edge card	17	21	54	8	0	0	6.0	4.5
D-Subminiature	19	33	29	19	0	0	6.0	3.2
Rack & panel	0	21	50	29	0	0	9.0	5.2
Power	15	16	46	23	0	0	7.6	3.7
PRINTED CIRCUIT BOARDS								
Single sided	0	42	54	4	0	0	5.8	5.4
Double sided	0	32	60	8	0	0	6.7	5.6
Multi-layer	0	0	67	33	0	0	10.6	7.4
Prototype	0	77	18	5	0	0	3.7	3.2
RESISTORS								
Carbon film	30	30	33	7	0	0	4.3	3.1
Carbon composition	44	16	40	0	0	0	3.5	5.1
Metal film	21	38	34	7	0	0	4.6	4.1
Metal oxide	15	30	50	5	0	0	5.4	7.1
Wirewound	12	28	48	12	0	0	6.3	5.8
Potentiometers	9	31	51	9	0	0	6.1	6.8
Networks	8	33	38	21	0	0	7.0	4.4
FUSES	24	47	29	0	0	0	3.2	3.5
SWITCHES								
Pushbutton	16	34	34	16	0	0	5.9	5.5
Rotary	5	41	45	9	0	0	5.8	7.4
Rocker	4	39	43	9	5	0	6.9	6.4
Thumbwheel	14	23	35	23	5	0	8.2	8.0
Snap action	21	29	38	8	4	0	5.9	5.6
Momentary	5	47	26	22	0	0	6.5	5.1
Dual-in-line	7	33	40	13	7	0	7.7	5.3
WIRE AND CABLE								
Coaxial	19	30	44	7	0	0	5.2	3.8
Flat ribbon	17	43	35	5	0	0	4.4	3.3
Multiconductor	17	26	52	5	0	0	5.4	3.0
Hookup	40	33	20	7	0	0	3.3	2.7
Wirewrap	27	36	23	14	0	0	4.8	3.3
Power cords	23	38	23	16	0	0	5.1	5.0
POWER SUPPLIES								
Switcher	0	32	42	21	5	0	8.6	7.0
Linear	7	29	35	29	0	0	8.0	6.0
CIRCUIT BREAKERS	7	13	53	27	0	0	8.8	6.9
HEAT SINKS	5	33	48	14	0	0	6.7	5.8
BATTERIES								
Lithium coin cells	7	43	29	21	0	0	6.5	4.8
9V alkaline	47	29	18	6	0	0	2.9	4.1
Real-time clock back-up	13	37	37	13	0	0	5.7	5.6
RELAYS								
General purpose	30	26	30	9	5	0	5.6	5.2
PC board	16	36	36	12	0	0	5.5	8.4
Dry reed	13	27	47	13	0	0	6.3	9.1
Mercury	0	8	46	46	0	0	11.2	8.2
Solid state	17	13	39	22	9	0	9.2	6.5
DISCRETE SEMICONDUCTORS								
Diode	25	27	28	17	3	0	6.2	7.3
Zener	17	33	17	30	3	0	7.6	9.0
Thyristor	18	18	50	14	0	0	6.6	9.4
Small signal transistor	34	21	34	11	0	0	4.9	10.9
MOSFET	21	16	31	32	0	0	7.9	8.6
Power, bipolar	15	27	35	15	8	0	7.8	6.9
INTEGRATED CIRCUITS, DIGITAL								
Advanced CMOS	8	12	41	35	4	0	10.1	8.8
CMOS	13	16	45	26	0	0	8.0	9.9
TTL	12	40	36	12	0	0	5.6	7.7
LS	20	20	43	17	0	0	6.5	8.4
INTEGRATED CIRCUITS, LINEAR								
Communication/Circuit	13	13	37	37	0	0	9.1	7.4
OP amplifier	17	23	30	30	0	0	7.6	8.6
Voltage regulator	20	28	32	20	0	0	6.3	7.4
MEMORY CIRCUITS								
DRAM 16K	0	10	27	45	9	9	14.6	13.3
DRAM 64K	0	21	21	29	21	8	14.6	13.8
DRAM 256K	0	5	16	37	16	26	19.5	17.3
DRAM 1M-bit	0	0	8	31	38	23	22.6	21.6
SRAM 4K × 4	0	12	29	29	24	6	15.3	14.2
SRAM 8K × 8	0	6	28	32	28	06	16.6	17.1
SRAM 2K × 8	0	6	25	25	38	6	17.8	15.9
ROM/PROM	8	8	15	61	8	0	13.2	7.5
EPROM 64K	6	6	35	53	0	0	11.4	10.8
EPROM 256K	0	5	33	52	5	5	13.9	11.7
EPROM 1M-bit	0	1	25	58	8	8	15.8	13.8
EEPROM 16K	0	0	31	61	0	8	14.7	11.6
EEPROM 64K	0	0	23	77	0	0	14.1	12.1
DISPLAYS								
Panel meters	0	29	57	14	0	0	7.3	8.4
Fluorescent	0	0	70	30	0	0	10.4	10.4
Incandescent	9	27	55	9	0	0	6.3	7.1
LED	4	39	35	22	0	0	7.1	5.7
Liquid crystal	0	17	17	66	0	0	12.2	11.0
MICROPROCESSOR ICs								
8-bit	15	20	30	30	5	0	8.9	8.9
16-bit	15	15	35	30	5	0	9.2	8.4
32-bit	20	7	26	27	13	7	12.0	10.8
FUNCTION PACKAGES								
Amplifier	0	20	53	27	0	0	8.9	9.2
Converter, analog to digital	0	20	47	33	0	0	9.4	10.4
Converter, digital to analog	0	21	43	36	0	0	9.6	10.4
LINE FILTERS	0	31	46	23	0	0	7.9	6.6
CAPACITORS								
Ceramic monolithic	17	31	24	28	0	0	7.0	6.3
Ceramic disc	25	25	29	21	0	0	6.1	7.3
Film	15	31	35	19	0	0	6.4	8.4
Aluminum electrolytic	19	25	26	26	4	0	7.7	8.7
Tantalum	11	21	46	18	4	0	8.0	7.4
INDUCTORS	11	26	26	37	0	0	8.5	7.4

Source: Electronics Purchasing Magazine's survey of buyers.

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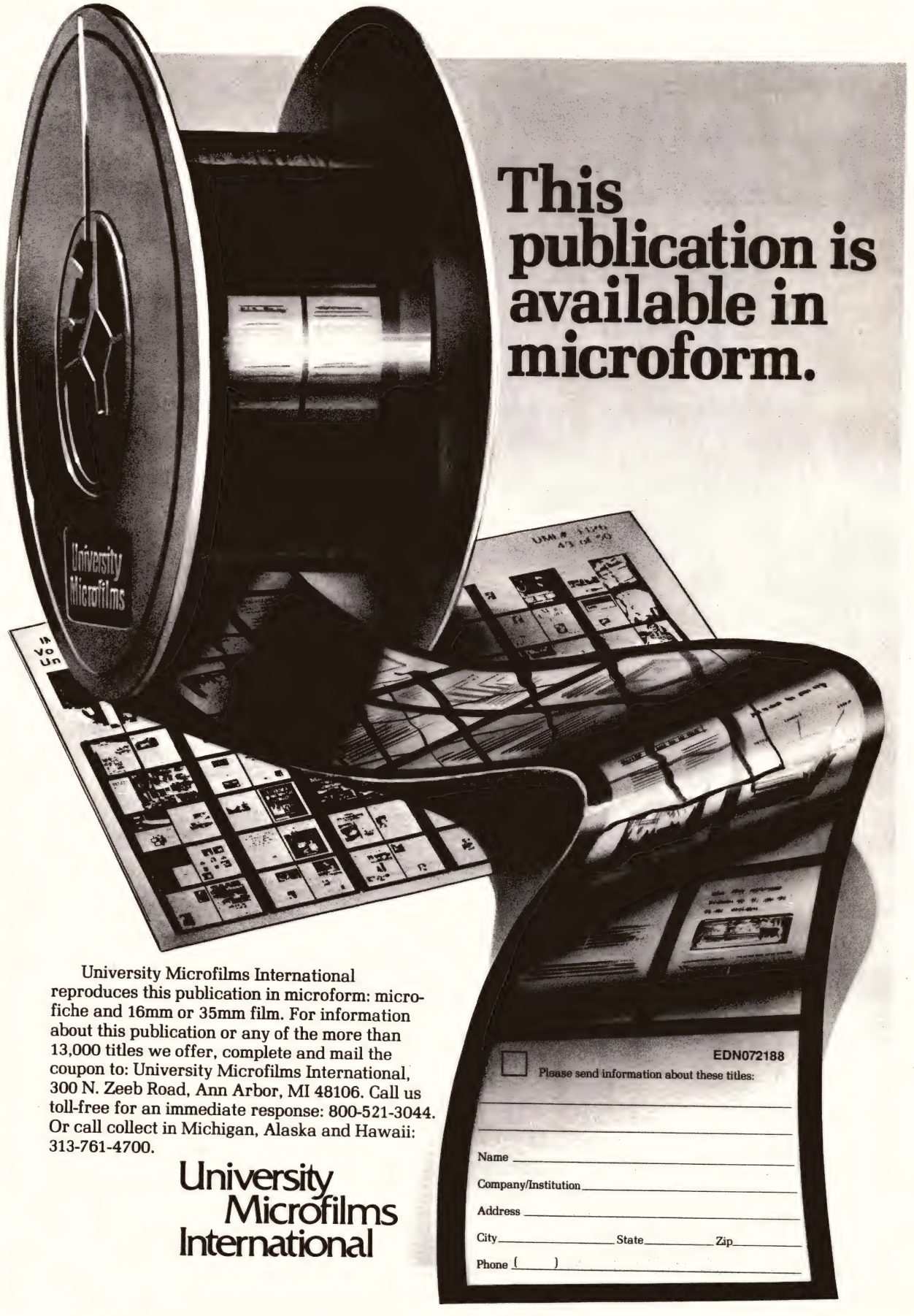
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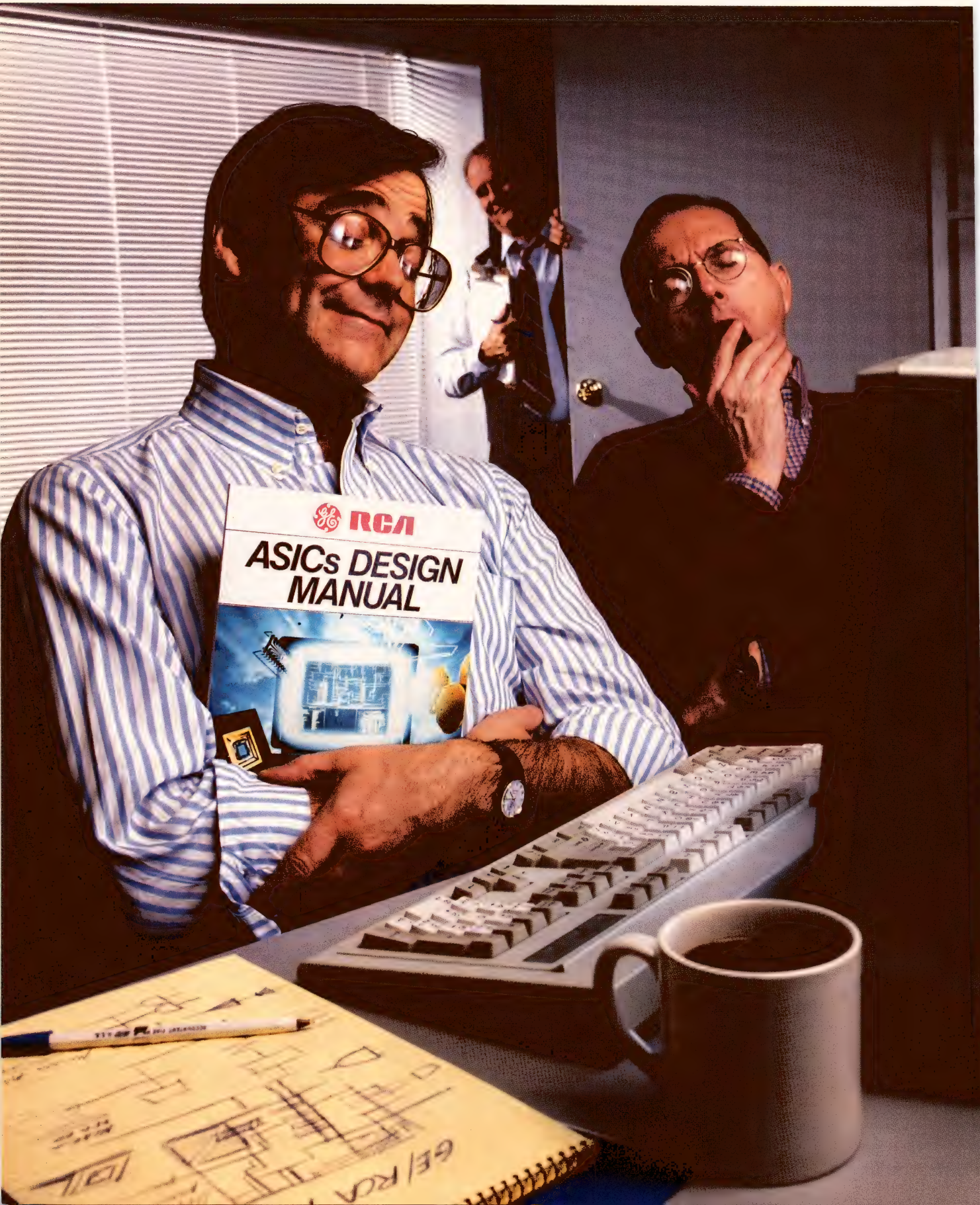
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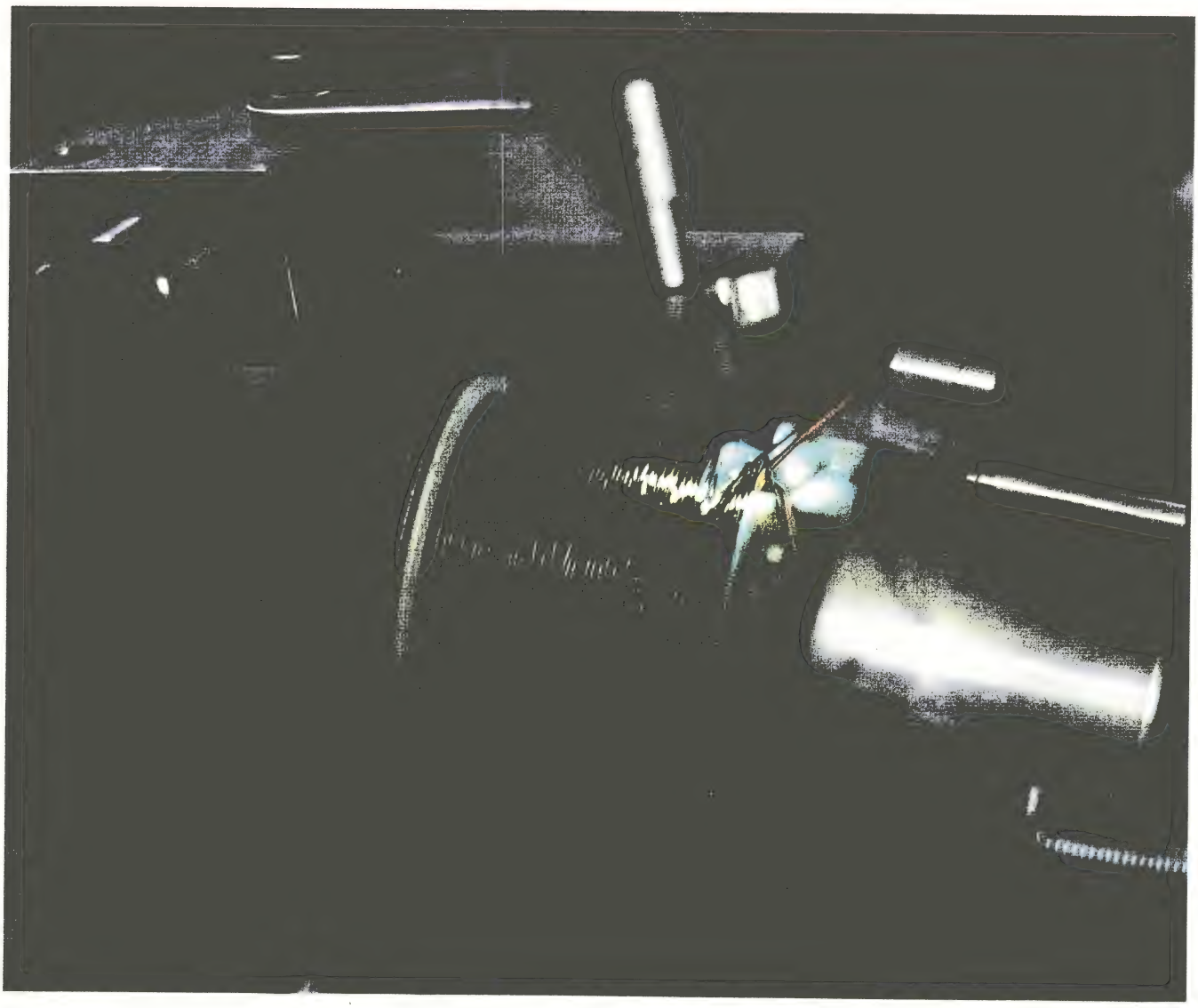
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Adhesives spread to all phases of electronics



Charles H Small, *Associate Editor*

New materials and new formulations of existing compounds are expanding the role of adhesives in virtually all phases of electronics manufacturing. Adhesives can not only replace mechanical fasteners for assembling components, but also serve in wire tacking, potting, sealing, and conformal coating.

As surface-mount technology (SMT) gains wider acceptance, adhesives will become even more common in electronics, because adhesives are vital for surface-mount applications. Special reels of conductive adhesive tapes feed SMT devices to automatic-placement equipment. Adhesives then hold tiny SMT devices in place prior to soldering. Water-soluble tapes protect vulnerable areas of a pc board from the ravages of the soldering process. And future conductive adhesives may replace metallic solders.

Adhesives, which are all formulated from a few basic chemistries, have a bewildering array of physical properties. Modern adhesives can be so thin that they can wick into and seal the smallest pores of a plastic component. Or they can be so thick that you can apply them in the form of a solid tape, much as you would a gasket. (Such solid tapes cement two surfaces together only when you apply pressure.)

Steady advances in chemistry and adhesive-application techniques have expanded the capabilities of modern adhesives. Although detailed expertise in adhesives is the purview of manufacturing engineers, electronics engineers should keep abreast of adhesive developments, which can affect electronic-design options.

The hoped-for universal adhesive that can join any two materials instantly without surface preparation and can form a high-strength, impervious bond (without emitting any noxious fumes or requiring the application of heat) is not quite on the market just yet. However, adhesive manufacturers can supply adhesives for virtually any combination of substrates and application environments. They can also advise your manufacturing department about suitable dispensing equipment and environmental controls.

Although adhesives are vital to all phases of electronics manufacturing—and therefore should be of interest to electronics engineers—actually specifying and working with adhesives requires an expert manufacturing engineer. The manufacturing engineer must work in close cooperation with the adhesive supplier.

Each adhesive supplier obtains pretty much the same raw materials from a few major suppliers, which are principally large chemical companies. The adhesive manufacturers then formulate, and in some cases partially cure, their adhesives' components. Because adhesive makers are reluctant to part with their proprietary formulas, you generally can't specify an adhesive's chemistry. Instead, the adhesive makers prefer to create an adhesive formulation specially to meet your performance specifications.

As an electronics engineer, therefore, you must take all adhesive applications charts with a grain of salt. A general statement about which adhesive sticks to which substrate could be inaccurate. Many other factors besides a substrate's composition may determine whether an adhesive will or will not stick to it. For example, different manufacturers that use the same plastic to make components could use different release agents in their molding processes. The release agents could have different effects on the strength of an adhesive's bond to the plastics. In the case of pc boards, although all fiberglass pc boards are similar, the properties of solder masks vary widely, and they can also affect an adhesive's bond strength.

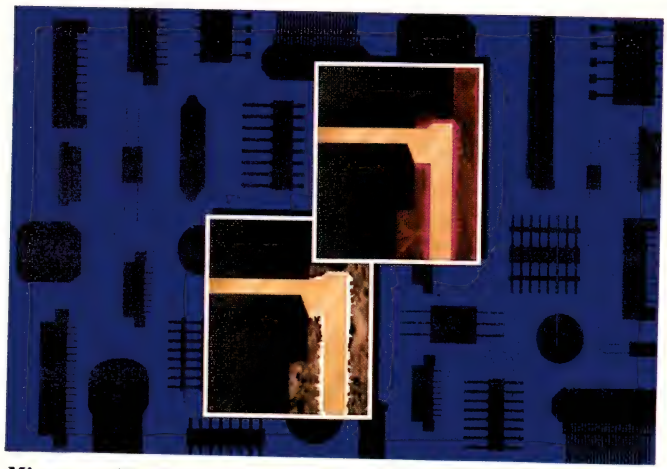
An adhesive engineer must, therefore, consider all of the following parameters when selecting an adhesive: viscosity, assembly automation, cure mechanism and speed, toxicity, durability, humidity and solvent resistance, and useful temperature range.

Most electronics engineers are familiar with the traditional application areas of adhesives in electronics. Adhesives hold surface-mount and other components in place, tack wires to pc boards, seal and pot electronic assemblies, secure nuts and potentiometers against vibration, and hold heat sinks in place, for example.

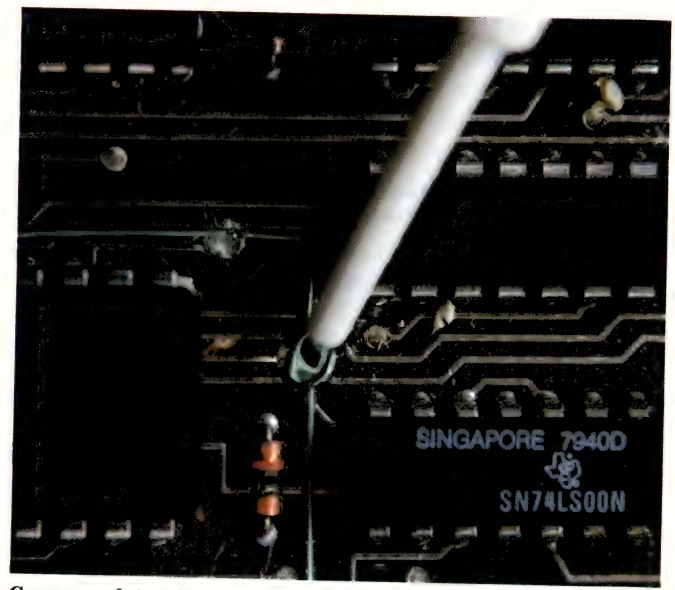
New electronics applications for adhesives include sealing the pores of plastic components and pc boards, reducing hum in transformers and chokes, replacing

Adhesive staking of coil winding *(Loctite Corp)*

Selecting the proper adhesive requires close cooperation between a manufacturing engineer and an adhesive supplier.



Microporosities before sealing (white areas) and after sealing (red areas) *(Loctite Corp)*



Cyanoacrylate-adhesive wire tacking *(Loctite Corp)*

metallic solders and mechanical connectors, and employing heat-conductive adhesives to mount power-dissipating parts. Mechanical devices used in electronic systems, such as stepping motors, are now often built up from bonded assemblies instead of from welded or mechnanically fastened ones.

A host of chemical innovations is making these new applications possible. For example, the same technology that produces gelled shampoos, paints, and toothpastes has led to gelled adhesives. You can apply gelled adhesives to vertical surfaces without the risk that the adhesive will run. Also, gelled adhesives do not soak into porous surfaces. Many new adhesives now come in gelled form. Unlike older epoxies, therefore, newer adhesives offer adjustable levels of viscosity.

All adhesives must be cured or activated. Curing and activating mechanisms for adhesives include mixing, heat, oxygen deprivation, moisture, activators, or radiation (UV or IR light or ion beams). Some new adhesives are especially suited to medical applications because they're nontoxic when cured. Some new cure mechanisms for adhesives allow for speedy assembly of the parts to be glued. Further, some new adhesives are single-component products, unlike products that require the user to mix two substances together just prior to application.

UV curing curtails contamination

Adhesive chemists have formulated ultraviolet (UV) light activators for most adhesives. Thin layers of these UV-activated adhesives can cure (at least partially) in seconds when exposed to UV light. And the UV-curing adhesives confer an additional benefit along with speed: They have fewer environmentally troublesome emissions than their conventionally curing cousins. Among the common types of adhesives used in electronics, only silicone adhesives currently lack a true UV-curing formulation (hybrid compounds of UV-curing and silicone adhesives are available, however). Silicone-adhesive manufacturers expect to have such an adhesive out within one year.

Quick curing is not without drawbacks, however. As an adhesives-industry adage puts it, "The faster they go together, the faster they come apart." Cyanoacrylate adhesives (which are sold as a consumer item under such trade names as "Krazy Glue" and "Super Glue") exhibit almost instantaneous curing. But these remarkable adhesives have one critical weakness: They're brittle after being cured.

By adding elastomers to their cyanoacrylate adhesives, adhesives manufacturers have traded off some curing speed for increased toughness and durability. With the addition of elastomers, cyanoacrylates prove useful for securing large components such as electrolytic capacitors, LEDs, connectors, switches, and transformers.

The quickly curing cyanoacrylates have also invaded the wire-tacking territory, which was already occupied by hot melts, tapes, silicones, and epoxies. The cyanoacrylate wire-tacking adhesives tack the wires faster than silicones and epoxies can. The trick they use is an accelerator spray. In practice, you apply a drop of cyanoacrylate adhesive, position the wire to be tacked,

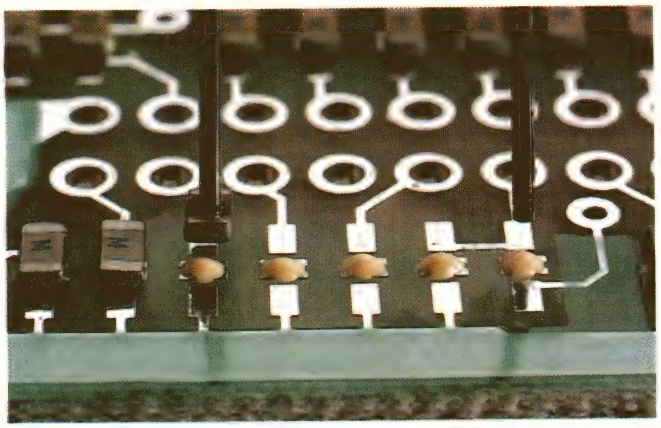
and then hit the glue drop with a spray of accelerator. The accelerator cures the adhesive almost instantly, freezing the wire in place. This basic method works across a broad range of wire-tacking applications, from securing jumper wires on pc boards to terminating coils.

Hybrids combine properties

As in the case of hybrid mixtures, such as the mixture of silicone and UV-curing adhesives, adhesive makers are combining two curing methods in one adhesive. For example, combining a fast-curing UV-activated adhesive with a slower anaerobic one gives you an adhesive that you can use to cement opaque substrates. The UV-activated curing agent will, when exposed to intense UV radiation, quickly tack the substrate in place by fixing the bead of adhesive, or fillet, that shows around the periphery of the substrate. At this point, you can handle the assembly, even though the anaerobic curing agent will take hours to achieve its final cured strength. Adding the UV-curing activator eliminates the lengthy cure cycle from your manufacturing process.

UV curing can also lower manufacturing costs and floor-space requirements. In one application, for example, a manufacturer was able to replace a 60-ft-long heat-cure oven with a 6-in.-long ultraviolet curing tunnel. UV-curing adhesives can cure in sunlight, and they eventually harden even under fluorescent lamps over several days' exposure.

Moisture-curing adhesives, on the other hand, polymerize when compressed into thin films during the assembly of plastic and metal components. The trace amounts of moisture present on the substrates' surfaces are sufficient to initiate the cure.



Securing SMDs with adhesive *(Emerson & Cuming)*

Taking a cue from the automotive industry, which has been sealing porous castings for years by vacuum-impregnating them with very thin resins, electronics manufacturers are now putting plastic assemblies, such as connectors, into vacuum tanks and impregnating the whole assembly with a sealant. This penetrating process is more effective than simply conformally coating an assembly.

Adhesives stand in for metallic solders

Although conductive organic polymers have been available for more than 15 years, until recently none could replace metallic solders. These polymers bonded poorly to tinned surfaces. Also, they were formulated from rigid epoxies that were brittle and not amenable to reworking. New conductive, surface-mount adhe-

The history of adhesives

The history of adhesives begins with mankind's earliest deliberate records. Cavemen mixed adhesives and pigments together to make the paint for prehistoric cave paintings. Tomb paintings dating from 2000 BC at Thebes, Egypt, depict workmen boiling hide glue in pots.

Early adhesives came from naturally occurring proteins such as those found in animal connective tissue and hides, from starches, and from naturally occurring gums and resins.

Modern synthetic resins date from the same era as synthetic plastics do. For example, cellulose nitrate adhesives appeared about 100 years ago, coeval with the appearance of cellulose nitrate billiard balls and piano keys. In 1910, the first modern synthetic-resin plastic, Bakelite, was closely followed by adhesives also made from phenol and formaldehyde.

Along with the wave of new synthetic polymers that swept over the world in the 1930s came a host of new adhesives. Indeed, chemists developed several new adhesives inadvertently while searching for new plastics. Acrylics, cyanoacrylates, and rubber di-isocyanates are examples of polymers that proved too sticky to be used as plastics but developed into superb adhesives.

Adhesive makers prefer to create an adhesive formulation to meet your performance specifications.



High-performance structural adhesives for bonding aircraft assemblies *(3M Aerospace Materials Department)*

TABLE 1—CHARACTERISTICS OF SOFT AND FIRM ADHESIVE TAPES

	SOFT	FIRM
INITIAL ADHESION	HIGH	LOW
ULTIMATE BOND	GOOD	HIGH
SUITABLE SUBSTRATES	MANY	FEW
RUBDOWN PRESSURE	LOW	FIRM
TEMPERATURE RESISTANCE	GOOD	EXCELLENT
SHEAR AND HOLDING STRENGTH	GOOD	VERY GOOD
SOLVENT RESISTANCE	GOOD	EXCELLENT
REMOVABILITY	GOOD	POOR

sives, however, can replace metallic solder for surface-mount components.

The new conductive surface-mount adhesives adhere to tinned surfaces and cure at much lower temperatures than the 80 to 140°C required for soldering. They require no flux, and they form bonds that are as strong and conductive as metallic-solder joints. Further, they have higher fatigue and shock resistance than does metallic solder, and they don't contaminate the pc board or components. To rework an assembly, you can melt the conductive adhesives by applying mild heat. Note however, that conductive polymers use silver to achieve conductivity, so they're much more expensive than tin-lead solder. Depending on your application, the lower manufacturing costs may offset the adhesives' higher material costs.

Conductive adhesive tapes are a new variation on foam tapes. The tape derives its conductivity from embedded, microscopic particles of silver-coated nickel. These particles are oriented within the tape from front to back. Consequently, the tape conducts only in its z axis. You can use this conductive tape to mount EMI/RFI shields. Further, you can take advantage of its anisotropic conductivity to join flexible circuits and

Theory of adhesion eludes scientists

One common myth, fostered no doubt by the innumerable TV programs, books, and articles written by scientists bent on popularizing science, is that scientists prove a scientific theory first and then manufacturers produce commercial products once the theory escapes from the laboratory. More often than not, however, technologists forge on, producing things that work, while scientists scratch their heads, vainly trying to figure out just why the products do work.

Vacuum tubes are one example. Scientists did not formulate an adequate theory for thermionic emission until shortly after the introduction of the transistor. Glue is another example. Mankind has used glues since the dawn of civilization. A large portion of our modern, industrial world hangs together because of adhesives. Products and processes ranging from the humble postage stamp to exotic aircraft depend on adhesives.

And yet, scientists still offer no single theory of adhesion. Currently you can take your choice of four theories:

- **Mechanical-linkage bonding**—The adhesive wets the surfaces of the two substrates thoroughly and fills all gaps and voids between them. When the adhesive cures and becomes solid, it physically locks the substrates together.
- **Electrostatic**—Static-electric charges on the adhesive's molecules bond the substrates together.
- **Diffusion**—Some of the adhesive's molecules actually penetrate the substrate.
- **Adsorption**—Chemical forces such as van der Waals force and hydrogen bonding allow the adhesive to bind the substrates to its surface.

COMMON ADHESIVE TYPES

ADHESIVE	ADVANTAGES	LIMITATIONS
CYANOACRYLATES	RAPID CURE SINGLE COMPONENT EXCELLENT ADHESION HIGH TENSILE STRENGTH INDEFINITE POT LIFE EASY DISPENSING	HIGH PRICE LIMITED GAP CURING POOR DURABILITY LOW SOLVENT RESISTANCE LOW TEMPERATURE RESISTANCE BANDS SKIN
ANAEROBICS	MODERATE PRICE HIGH STRENGTH RAPID CURE GOOD SOLVENT RESISTANCE VARIABLE VISCOSITIES NONTOXIC NO MIXING INDEFINITE POT LIFE EASY DISPENSING EASY AUTOMATION	LIMITED GAP CURING NOT FOR PLASTIC, RUBBER AIR PREVENTS CURING 300-400°F LIMIT
ACRYLICS	MODERATE PRICE GOOD GAP CURE GOOD IMPACT, PEEL, SHEAR MEDIUM/FAST CURE FORGIVES DIRTY SURFACES WORKS ON MANY SURFACES	CURES MORE SLOWLY THAN ANAEROBICS HOT STRENGTH UNDER 300°F PRIMER REQUIRED SOME ODOR, TOXICITY FLAMMABLE CONTAINS VOLATILES
URETHANES	MODERATE PRICE TOUGH, FLEXIBLE ADHERES TO MANY MATERIALS TWO-PART OR OVEN CURES FLEXIBLE AT LOW TEMPERATURES	POOR TEMPERATURE RESISTANCE SENSITIVE TO MOISTURE MIXING NEEDED; TOXIC SHORT POT LIFE DAMAGED BY HEAT
SILICONES	MODERATE PRICE GOOD GAP FILLING GOOD FOR GLASS LOW-STRESS SEALANT FLEXIBLE HIGH TEMPERATURE RESISTANCE GOOD WATER RESISTANCE MANY COLORS, VISCOSITIES EASILY APPLIED	LOW STRENGTH LIMITED SOLVENT RESISTANCE TOO FLEXIBLE SLOW CURING NEEDS MOISTURE TO CURE SHORT SHELF LIFE HARD TO CLEAN CORROSIVE EXPENSIVE TO AUTOMATE
EPOXIES	LOW PRICE GOOD GAP FILL HIGH STRENGTH GOOD TEMPERATURE/ SOLVENT RESISTANCE MANY FORMULATIONS	EXOTHERMIC REACTION CAREFUL MIXING NEEDED SLOW CURING, POT LIFE TOXIC, HARD TO APPLY SOME NEED REFRIGERATION, OVENS
HOT MELTS	LOW PRICE GOOD GAP FILL RIGID, FLEXIBLE BOARDS FAST SETTING VERSATILE FORMULAS	LOW STRENGTH POOR WETTING, CREEP LOW HEAT RESISTANCE MESSY, STRINGY HARD TO AUTOMATE DEGRADED BY HEAT
SOLVENT CEMENT	LOW PRICE EXCELLENT WETTING MANY SPECIAL TYPES EASILY APPLIED MODERATE CLAMPING NEEDED LONG SHELF LIFE NO SPECIAL EQUIPMENT	LOW STRENGTH POOR GAP CURING SHRINKS AS MUCH AS 70% SLOW DRYING POOR TEMPERATURE RESISTANCE ATTACKS PLASTICS FLAMMABLE HARD TO AUTOMATE POOR SOLVENT RESISTANCE

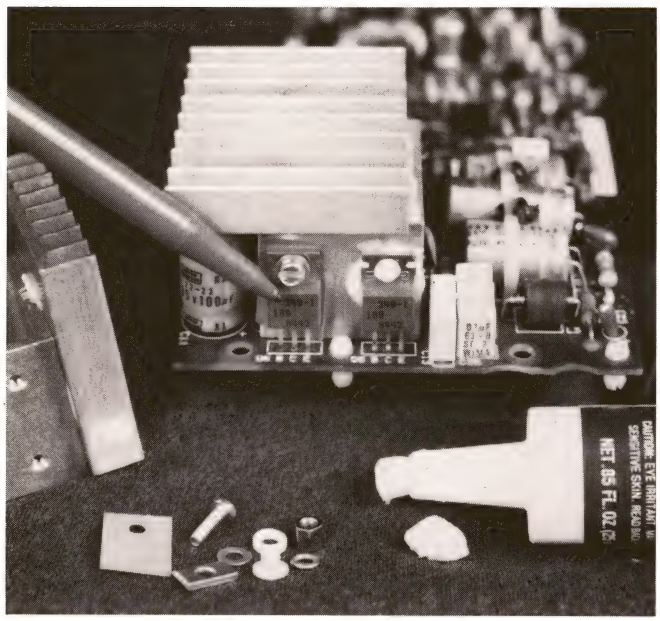
(COURTESY LOCTITE CORP)

mount components; the conductive tape will adhere to the entire component and electrically connect only corresponding conductors on both sides of the tape. The tape will not, however, short out a component's adjacent conductors or a pc board's adjacent fingers. You can also obtain three grades of thermally conductive adhesives for permanent, repairable, or self-shimming applications. These adhesives cure within two minutes.

Although new adhesive formulations appear almost daily, a grasp of adhesives' basic properties is valuable. The types of adhesive currently used in electronics include epoxies, acrylics, anerobics, cyanoacrylates, silicones, hot melts, pressure-sensitive tapes, and solvent cements.

Epoxies offer excellent temperature and solvent resistance. They also fill gaps. But epoxies have high viscosity and variable surface wetting, which is the ability of a liquid to coat a surface thoroughly, leaving

Although new adhesive formulations appear almost daily, it's valuable to have a firm grasp of adhesives' basic properties.



Thermally conductive adhesive *(Loctite Corp)*

RELATIVE PRICE INDEX OF 24 ADHESIVES

CYANOACRYLATES	400
ANAEROBICS	100
NYLON	8
SILICONE	8
POLYVINYL BUTYRAL	5
POLYURETHANE	4
CASEIN	3
NEOPRENE	2.5
NITRILE RUBBER	2.4
ACRYLICS	1.9
EPOXIES	1.9
ETHYLENE-VINYL ACETATE	1.6
POLYVINYL ALCOHOL	1.6
BUTYL	1.4
ANIMAL GLUES	1.1
POLYVINYL ACETATE	1
STYRENE-BUTADIENE RUBBER	1
POLYETHYLENE	0.9
PHENOL-FORMALDEHYDE	0.7
DEXTRINS	0.5
UREA-FORMALDEHYDE	0.3

NOTES:
1. RATIO IS TO PRICE PER POUND OF POLYVINYL ACETATE, DRY BASIS
2. INFORMATION FROM HANDBOOK OF ADHESIVES (REF 2)

no gaps or bubbles. Often you must mix two components just prior to application. What's more, epoxies often require a heated curing cycle. Their pot life is limited and, consequently, waste is high and cleanup is difficult.

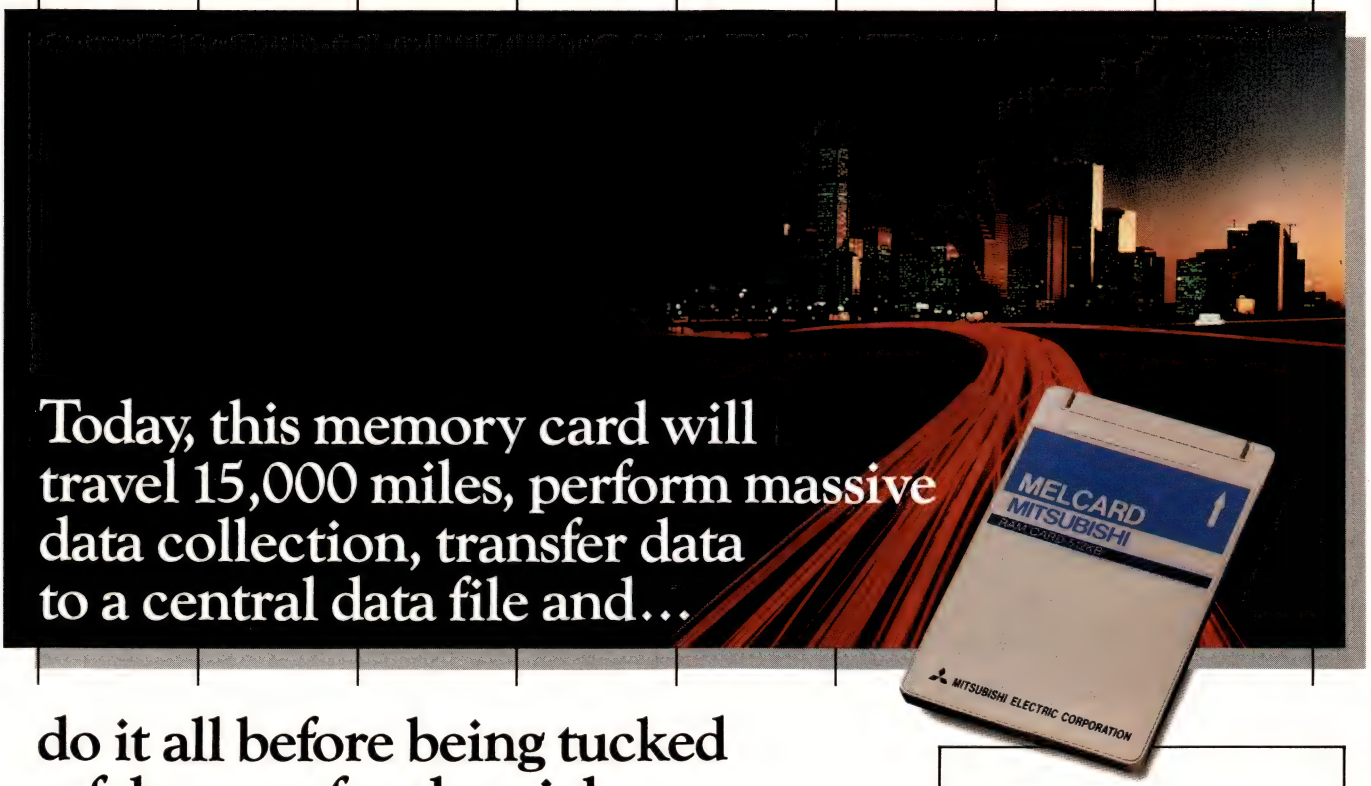
Acrylics gained prominence as competitors for epoxies during the 1970s. Acrylics are nearly as strong as epoxies, and they possess two major advantages: They cure quickly at room temperature, and they do not require you to mix two components. Instead, you coat one substrate with the adhesive and the other with the curing agent. You can store the pretreated parts for weeks before joining them. Newer acrylics require less surface preparation than other adhesives—you can even bond slightly oily metal surfaces with the acrylics.

Although they have other applications, anaerobic adhesives are best known for securing mechanical fasteners against vibration. These thread-locking adhesives have the unusual property of remaining liquid in the presence of oxygen. When confined to a small area, such as the gap between the threads of mechanical fasteners or the pores of a casting, where they are deprived of oxygen and in the presence of iron or copper, anaerobics cure to a solid state.

New formulations of cyanoacrylates overcome some of the problems of early versions. For example, the original cyanoacrylates had a very thin consistency and were suitable only for horizontal surfaces. You can now get thicker, jelled formulations that don't run. As mentioned, you can also obtain toughened cyanoacrylates that are mixed with elastomeric materials, and thus are less brittle than earlier formulations. Odor-free cyanoacrylates require less ventilation, and non-frosting versions leave no white residue. Automotive applications have spawned cyanoacrylates that work at higher temperatures.

Single-part silicones cure from the moisture in the air. Newer silicone formulations offer better adhesion, oil resistance, and cure speeds. Silicones' high-temperature performance and flexibility make them suitable for joints that are subject to much expansion and contraction. Few, if any, organic (carbon-based) polymers can match silicones' −55 to +125°C temperature range. Silicones are more resilient than most adhesives, and they also have a far lower glass-transition temperature. In the past, the major bar to using silicones in electronics was their long curing time. The moisture-curing silicones cure to a tack-free state in three to four hours. These silicones were essentially electrical-grade bathroom caulking. Now, you can obtain silicones that cure more quickly at elevated temperatures. Also, early silicones released an acetoxy (acetic acid) byproduct of curing which could be corrosive. Reformulated silicones release an alcohol as a byproduct of cure.

Hot-melt glues melt at between 200 and 300°F. These waxy glues are some of the few adhesives that adhere to



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VSOP

13.8 mm x 8.0 mm x 1.0 mm = 110.4 mm³



Chip-On-Board

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SOP

17.5 mm x 12.2 mm x 2.2 mm = 469.7 mm³

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The key to Mitsubishi's extremely high density memory cards is the VSOP (very-small-outline-package). Pioneered by Mitsubishi, the VSOP is over four times smaller (in overall volume) than its equivalent pin count, standard surface mount package. In fact, the VSOP is smaller than the footprint of the equivalent chip-on-board technology making it possible to pack up to 16 memory ICs, plus standard interface circuitry on one card.

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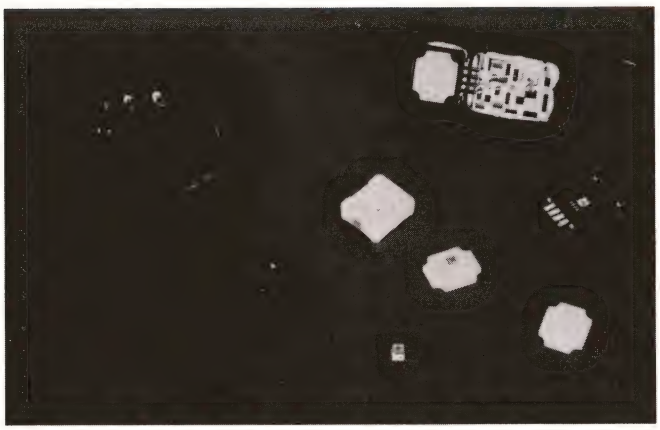
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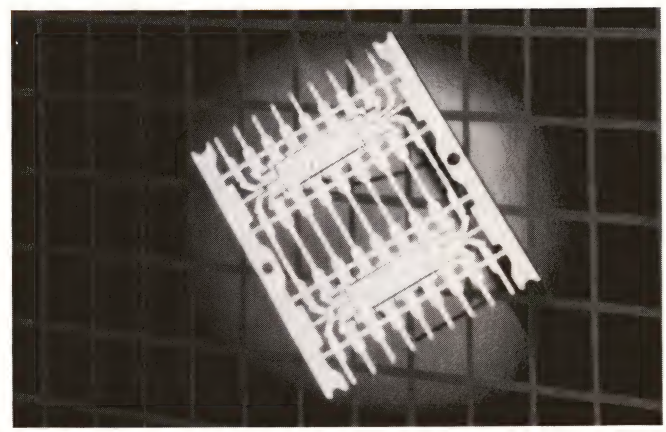
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SOUTH ATLANTIC, Norcross, GA (404) 662-0813
SOUTHEAST, Boca Raton, FL (305) 487-7747
CANADA, St. Laurent, Quebec, (514) 337-6046

According to a rule of thumb in the adhesives industry, "The faster they go together, the faster they come apart."



Sealed electronic assemblies *(Emerson & Cuming)*



Bonded lead frame *(Emerson & Cuming)*

polyethylene and other slippery plastics. Obviously, hot melts are not the proper choice for high-temperature applications. Right now, the automotive industry is taking the lead in using hot melts. Modern auto bodies incorporate many hot-melt preforms that liquefy and seal body panels during the paint-bake cycle.

Rubber and acrylic-based pressure-sensitive tapes are well-known products. Rubber-based adhesive tapes are not suitable for high-temperature applications. However, they exhibit their final bond strength quickly. Rubber-based tapes are suitable for temporary applications because you can remove them easily, yet, in comparison with other tapes, they provide better long-term adhesion to materials with low surface energy such as polyethylene and polypropylene.

Acrylic-based tapes, on the other hand, work over a broader range of temperatures and resist moisture and UV light better than rubber-based tapes do. Silicone-based tapes are available for specialized applications. Adhesive tapes come with either soft or firm adhesives (**Table 1**). The foams are commonly polyurethane, polyethylene, or polyvinyl chloride.

Solvent welding isn't really gluing at all; the solvent temporarily softens the surfaces to be joined, allowing you to weld them together without glue. The technique has limitations: No universal solvent exists for all plastics, and the technique is limited to thermoplastics. The solvents also exhibit considerable evaporation and emit noxious fumes. You can also have problems with leakage, because the technique fills no gaps. Such welds are also prone to stress cracking.

Welding gives the finished product a clean, neat appearance, and it can be done at high speed with automatic equipment. But it can also allow leakage because it doesn't create a 100% seal and doesn't work with all substrates. **EDN**

For more information . . .

The manufacturers in this list provided information for this article. The list is not exhaustive; over 100 adhesive makers offer more than 25,000 different products. For more information on adhesives, contact the following manufacturers directly, circle the appropriate numbers on the Information Retrieval Service card, or use EDN's Express Request service.

Emerson & Cuming
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TWX 710-348-1324
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Newington, CT 06111
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(416) 625-6511
Circle No 367

3M Corp
Industrial Tape Div
Industrial Specialties Div
Aerospace Materials Dept
3M Center
St Paul, MN 55144
(612) 733-3929
Circle No 368

References

1. *Adhesives Red Book*, Communication Channels Inc, 6285 Barfield Rd, Atlanta, GA 30328; phone (404) 256-9800.
2. Skeist, Irving, ed, *Handbook of Adhesives*, Van Nostrand Reinhold Co, New York, NY.

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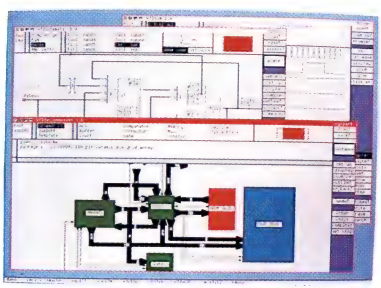
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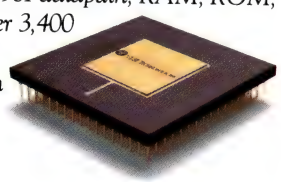
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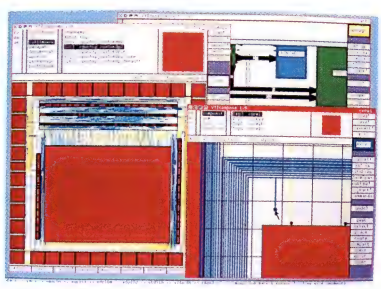
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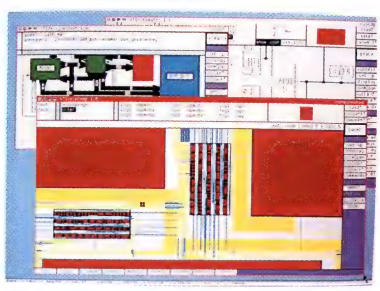
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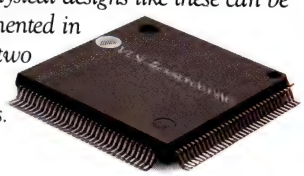
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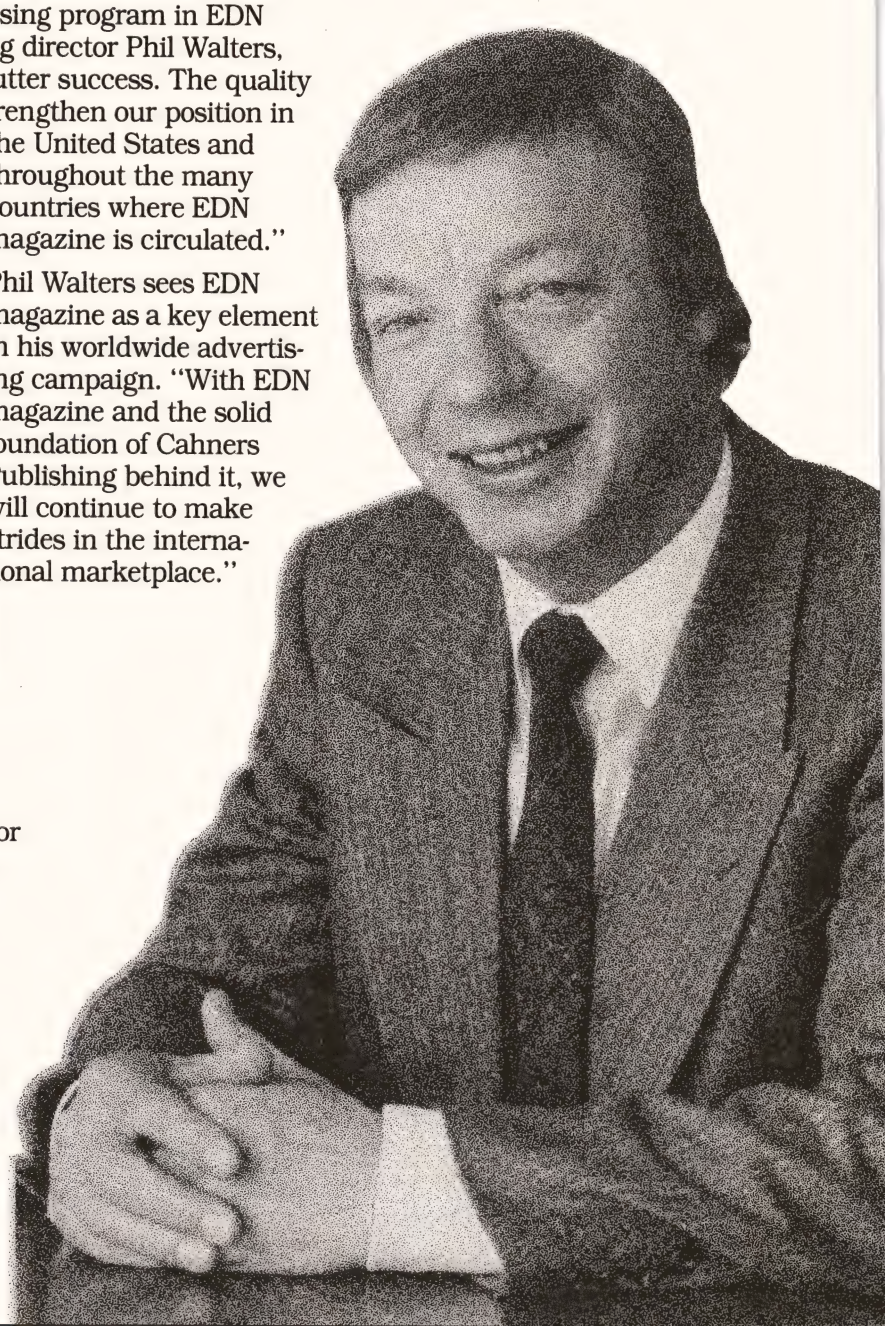
Based in England, Hunting Hivolt is a leader in high-voltage technology. Yet the company wanted to further enhance its international image and gain an even greater awareness with engineers and engineering managers worldwide.

What was the answer?

First, set up a facility in the United States. Then support it with an advertising program in EDN magazine. Says marketing director Phil Walters, "The result has been an utter success. The quality of response has helped strengthen our position in the United States and throughout the many countries where EDN magazine is circulated."



Phil Walters sees EDN magazine as a key element in his worldwide advertising campaign. "With EDN magazine and the solid foundation of Cahners Publishing behind it, we will continue to make strides in the international marketplace."



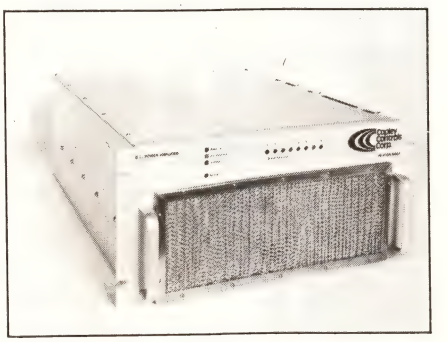
Advertising in EDN magazine works for Hunting Hivolt. It can work for you.

EDN

Where Advertising Works

High-power PWM amplifier features microprocessor control

The Model 290, a rack-mountable, pulse-width-modulation power amplifier, provides peak outputs of ±160V at either ±300A for the 290-06 version or ±400A for the 290-08 version over a dc to 3-kHz bandwidth. You can operate each amplifier either as a voltage or current source. The signal-processor board processes the input signal for a particular application and includes a switch for voltage-, current-, or test-mode operation. You can parallel as many as 30 amplifiers in a master-slave configuration to develop ±7000A at ±160V continuous power. The full-load heat dissipation equals 1500W, so efficiency specs at 95%.



The amplifier can achieve full output within 1 msec. The dc stability equals 50 ppm/°C after 30 minutes of warmup. Configured as a voltage source, the Model 290 operates with a load resistance as low as 40 mΩ and delivers sine-wave outputs as high as 25 kVA. The small-signal response measures ±1 dB from dc to 10 kHz and ±2 dB at 15 kHz. The total harmonic distortion (THD) between 20 Hz and 1 kHz equals 2% max for a 25 kVA output. As a current source, the device operates with loads ranging from 50 μH to 50H and with series resistance from 0 to 5Ω. For a 150A rms output, the THD equals 0.2% max at 200 Hz.

You can adjust the amplifier's transient response from an underdamped to a controlled overshoot level. The power-supply sensitivity is only ±100 μA/V, so the amplifiers will operate with any unregulated supply voltage in a 65 to 165V range. $18,000. Delivery, six weeks.

Copley Controls Corp, 375 Elliot St, Newton, MA 02164. Phone (617) 965-2410. TLX 285975.

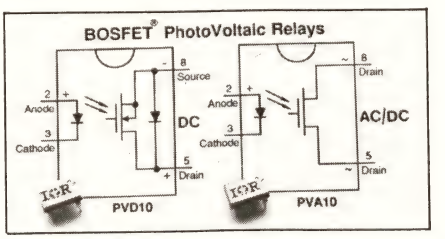
Circle No 357

Low-capacitance solid-state relays increase speed and reduce crosstalk

These miniature, photovoltaic-type relays have output capacitance as low as 2 pF and switching speeds of 25 μsec max. Because of these characteristics, the devices can handle 20k-baud data rates and can dramatically reduce crosstalk.

The PVD10 and the PVA10 relays have a 20:1 forward current gain and will switch 160 mA max. The PVD10 is configured to switch analog signals from thermocouple levels to 100V dc. The PVA10 is configured to switch 100V ac or dc. Both are single pole, normally open devices.

Control-current needs range from 2 to 25 mA. On-state resistance specs at 7.5Ω and 35Ω for the PVD10 and PVA10, respectively.



Each is available in two off-state resistance versions—values are 1×10^{10} and $1\times10^{8}\Omega$. Input-to-output dielectric strength equals 4000V rms, and maximum I/O capacitance measures 1 pF.

The relay design uses the company's BOSFET power ICs, which are controlled by a photovoltaic generator. The monolithic BOSFET contains a bidirectional n-channel power MOSFET output structure; the gate-protect, fast turn-on input circuitry is fabricated in both bipolar and MOS technologies to form npn transistors, p-channel MOSFETs, resistors, diodes, and capacitors.

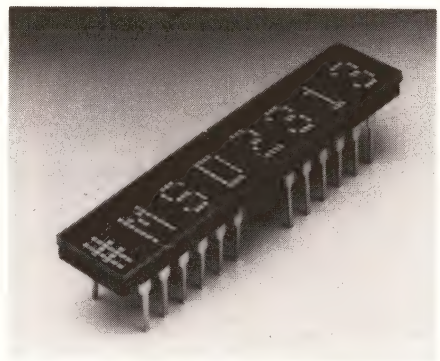
PVD10 and PVA10 relays are housed in board-mountable 8-pin dual-in-line molded epoxy packages. Operating range spans −40 to +85°C, and switching life specs at 1×10^{10} operations min. $3.18 to $3.66 (1000). Delivery, two to 10 weeks ARO.

International Rectifier Corp, 233 Kansas St, El Segundo, CA 90245. Phone (213) 607-8862.

Circle No 360

Four-digit industrial displays handle harsh environments

MSD2000/2300 and ISD2000/2300 4-character, 5×7 dot-matrix displays feature CMOS circuitry for low power consumption. Suited to military and industrial environments, the devices are housed in hermetically sealed 12-pin DIPs and operate over −55 to +100°C. The MSD2000 and ISD2000 displays provide 0.15-in. characters; the MSD2300 and ISD2300 displays offer 0.2-in. characters. You can specify red, yellow, green, or high-efficiency red LEDs.



Each display package includes two 14-bit CMOS shift registers (7 bits per character) with built-in row drivers. These shift registers drive 28 rows, letting users define customized fonts. You can easily cascade the packages in either the X or Y direction to develop multiple character displays. And the display's Data In and Data Out pins make it easy to cascade multiple displays. You can input Data In and Out with the clock signal and display the data in parallel using the row drivers. You can tie the TTL-compatible V_B input to V_{CC} for maximum display intensity or use a pulse-width-modulated signal to achieve intensity control and reduce power consumption.

The 4-digit displays are also available in versions (yellow, green, or high-efficiency red, 0.2-in. characters) that are viewable in direct sunlight. ISD 2000, $58 to $83 (100); $91 to $104 for sunlight-viewable units. MSD 2000, $120 to $165 (100); $183 to $196 for sunlight-viewable versions.

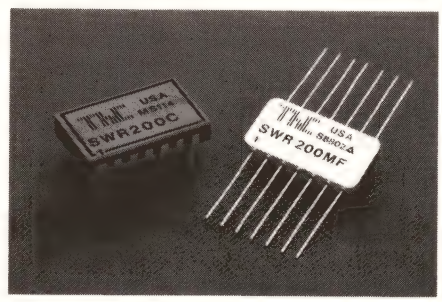
Siemens Components Inc, Optoelectronics Div, 19000 Homestead Rd, Cupertino, CA 95014. Phone (408) 257-7910. TWX 910-338-0022.

Circle No 359

Precision sine-wave reference boasts ±0.02% initial accuracy

The SWR200 precision sine-wave oscillator provides an ultrastable 7.07V at ±10-mA output. Initial output amplitude accuracy specs at ±0.02%, and the unit is available with temperature coefficients as low as 2 ppm/°C over the full −55 to +125°C temperature range.

The oscillator also has a long-term stability of 10 ppm/1000 hrs. A chopper-based AGC circuit provides the key to the device's performance. The temperature characteristic of the chopper circuit compensates for the typical nonlinearity of the internal dc zener reference to provide a nearly linear amplitude vs temperature characteristic.



Using only two external capacitors, you can program the SWR200 to output a frequency in the 0.4- to 10-kHz range. The device has two separate ground pins to provide accurate ground sensing and eliminate errors due to ground drops.

Oscillator warmup drift specs at 100 μV. Maximum dc offset equals 3 mV at 25°C and 18 μV/°C over temperature. Typical line and load regulation are 10 ppm/V and 3 ppm/mA, respectively. Maximum output-frequency drift vs temperature measures 15 ppm/°C, and total harmonic distortion (at 3.3 kHz) equals 0.5% max.

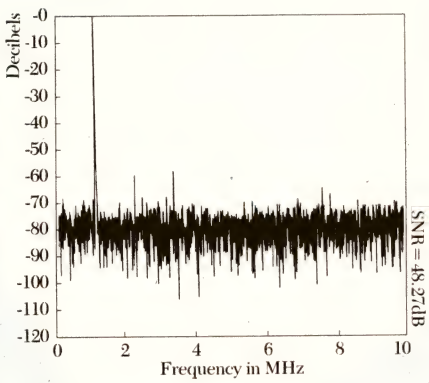
The SWR200 operates from ±15V supplies. It comes in a 14-pin flatpack or a 14-pin DIP. Both packages are hermetically sealed, and M versions are fully screened to MIL-STD-883C requirements. $86 to $112.20 for DIP versions; $98 to $126.09 (100) for flatpack units.

Thaler Corp, 10940 N Stallard Pl, Tucson, AZ 85737. Phone (602) 742-5572. TLX 825193.

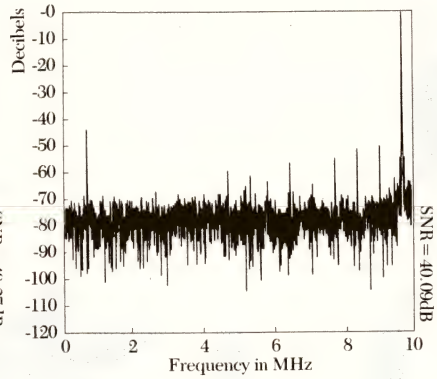
Circle No 361

THE THRILL OF DESIGNING A/D SUPPORT CIRCUITRY ENDS IN A FLASH.

The thrill of designing voltage references, input buffers, timing, and adjustment circuitry is gone. We do it for you. And in hybrid packages smaller than you'd expect for flash converters alone.



FFT of HS1068 Flash Converter,
Fin = 1.123MHz, Fsample = 20MHz

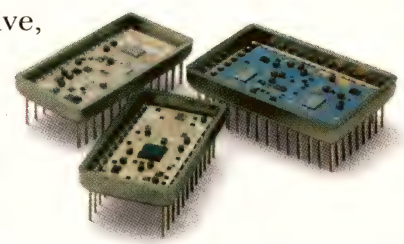


FFT of HS1068 Flash Converter,
Fin = 9.678MHz, Fsample = 20MHz

Consider these three "pop-in" converters. Our 8-bit HS1068 flash A/D samples at 20MHz minimum, has no spurious or missing codes, aperture jitter of only 60ps, and true 1/2 LSB 8-bit 47dB signal-to-noise ratio. Our 8-bit SP1070 samples at 25MHz minimum and requires only 1W of power. And our dual-flash SP1072 provides the performance of two SP1070s while saving you considerable real estate.

Naturally, we test each device to ensure maintenance of SNR as input frequencies climb. They'll be distortion-free in your hypersensitive DSP applications.

And, we are the only company you can rely on to deliver full MIL-STD-1772 and MIL-STD-883C, self-contained, hybrid flash converters off the shelf. For data sheets, or a copy of our 382-page 1988 catalog, write SIPEX Corporation, Six Fortune Drive, Billerica, MA 01821, or call 1-800-272-1772. In Massachusetts call (617) 663-7811.



Sipex Corporation Hybrid Systems Division

SIGNAL PROCESSING EXCELLENCE

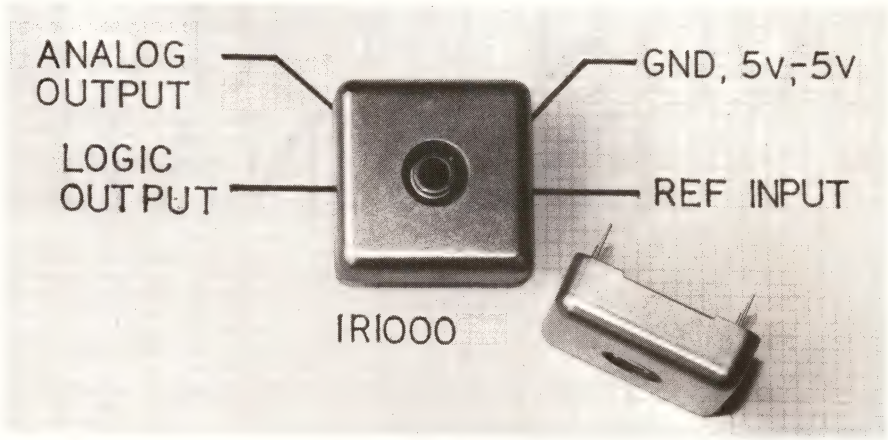
CIRCLE NO 50

Passive infrared sensing module outputs digital logic signal

The IR1000 infrared sensing module outputs a digital logic signal in response to changing temperature (such as that caused by body heat) within its field of view. As a result, it lends itself to a wide range of intrusion-detection and industrial-monitoring applications.

To accommodate various sensing ranges, you can adjust the device's sensitivity with the reference input. Daylight operation presents no problems for the module because it responds to changes in infrared radiation in the 8- to 14-μm range—the optimal range for atmospheric transmission of 95°F (skin temperature) radiation. To provide some degree of noise immunity, the module will reject signal fluctuations outside the 0.1- to 10-Hz range.

The digital output can drive either TTL or CMOS logic families. The buffered output ensures that the IR1000 will output 150 mA and still maintain CMOS voltage levels. The active low output provides an indication of unauthorized tampering.



The module also provides an analog representation of the received infrared radiation for measurement applications such as remote temperature sensing or gas concentration measurement. The IR1000 will respond to flame and and hot gases in fire-alarm applications.

The surface-mount circuitry of the IR1000 is encapsulated in epoxy and potted in a metal housing to provide environmental protection. The unit's pins are arranged on a 0.1-in. grid to facilitate pc-board mounting. $25 (100).

Infrared Inc, Box 47, Parlin, NJ 08859. Phone (201) 721-7160.

Circle No 362

SMD multilayer varistors protect I/O lines from ESD damage

Though small in size, the MLV multilayer varistors can protect sensitive I/O signal lines from voltage spikes caused by ESD, lightning, nuclear-electromagnetic pulse, or other transient phenomena. Precise control of the device's zinc oxide grain size and structure plus multilayer construction create devices with well-defined, repeatable breakdown voltages determined by design instead of by lot selection and testing.

The vendor offers varistors with two voltage ratings. Typical breakdown voltages are 7.8 and 18.5V; respective maximum clamping voltages equal 15.5 and 30V. You can obtain the product in two case styles: a 1206 surface-mountable package and a conformally coated, axial-lead device. Varistors of either voltage rating absorb peak currents of 200A. The 1206 SMD absorbs 0.45J, and the axial-lead component absorbs 0.8J. Both package styles exhibit inductances of 1.7 nH. The SMD style exhibits 3.0 nF of capacitiance, and the axial device exhibits 1.5 nF.

Though a 7.8V breakdown voltage may seem high for protecting 5V logic signals, most IC inputs and outputs incorporate ESD protection circuits that withstand transients of 500V or more. So limiting voltage transients to less than 16V keeps these spikes well below the devices' safety margins. The SMD and axial-leaded versions of the MLV cost $0.49 and $0.54 (10,000), respectively.

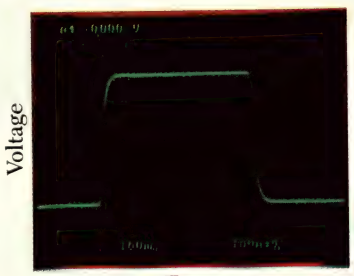
AVX Corp, Box 867, Myrtle Beach, SC 29577. Phone (803) 448-9411. TWX 810-661-2252.

Circle No 358

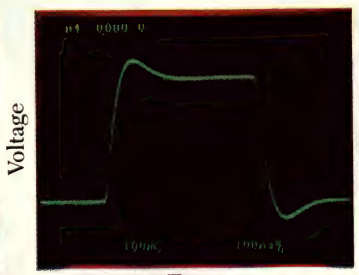
WHY YOUR SECOND SOURCE SHOULD BE YOUR FIRST CHOICE.

First of all, better performance. In high speed op-amp applications you need high slew rate, but not without good phase margin, low overshoot, and fast settling time. Sipex covers you on all counts. Look at our SP2510 op-amp. It achieves *its* 65 V/μsec slew rate with better phase margin, less than 5% overshoot, and a settling time of under 250 nSec. Our other high speed op-amps, such as the SP2500/02/05, SP2520/22/25, SP2600/02/05, and the SP2620/22/25, offer you an equivalent edge.

And there's more. We'll deliver these high performance products *without* the usual hassles.



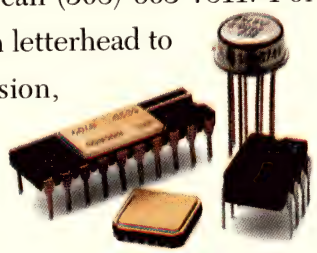
OUR 2510



THEIR 2510

Our op-amps come in the package you need, when you need them, and are specified to your commercial or military requirements, including MIL-STD-883 screening. That's second sourcing that puts you first every time.

For a free copy of our 382-page 1988 catalog, call our Sipex literature hot line: 1-800-272-1772. In Massachusetts call (508) 663-7811. For product samples, write on letterhead to Sipex, DataLinear Division, 491 Fairview Way, Milpitas, CA 95035



Sipex Corporation DataLinear Division

SIGNAL PROCESSING EXCELLENCE

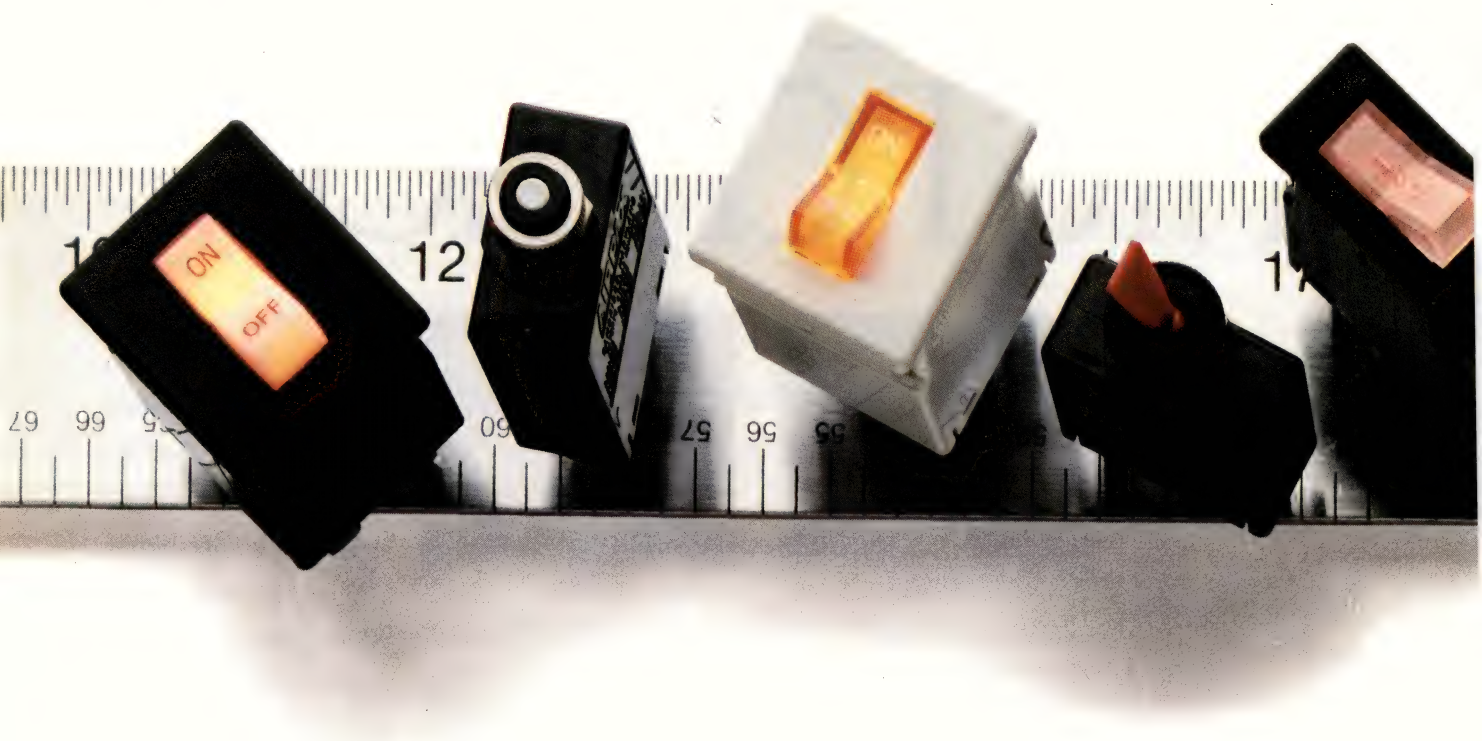
CIRCLE NO 51

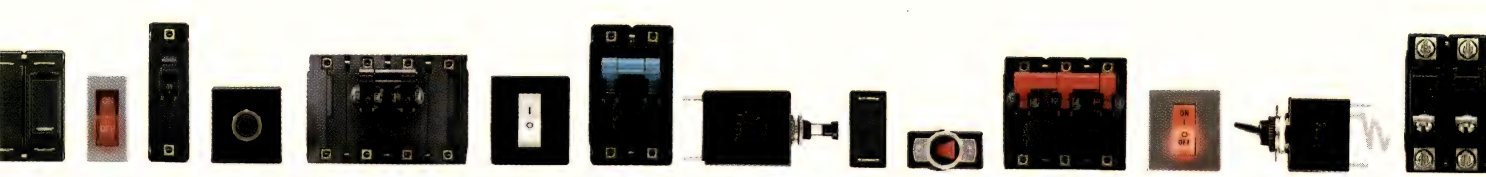
CHOICE
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選択

For circuit breaker choice that's recognized throughout the world, Airpax has the answer. Our SNAPAK® circuit breakers are available with rocker, toggle, paddle, baton, push-pull or push-to-reset actuation. They offer you a wide choice of reliable, magnetic circuit protection to provide precisely the right style, configuration and rating for your designs.

For enhanced aesthetics in front-panel applications, the SNAPAK family includes paddle, rocker, and baton handles in seven attractive colors. Also available are illuminated rocker handles in LED or neon.

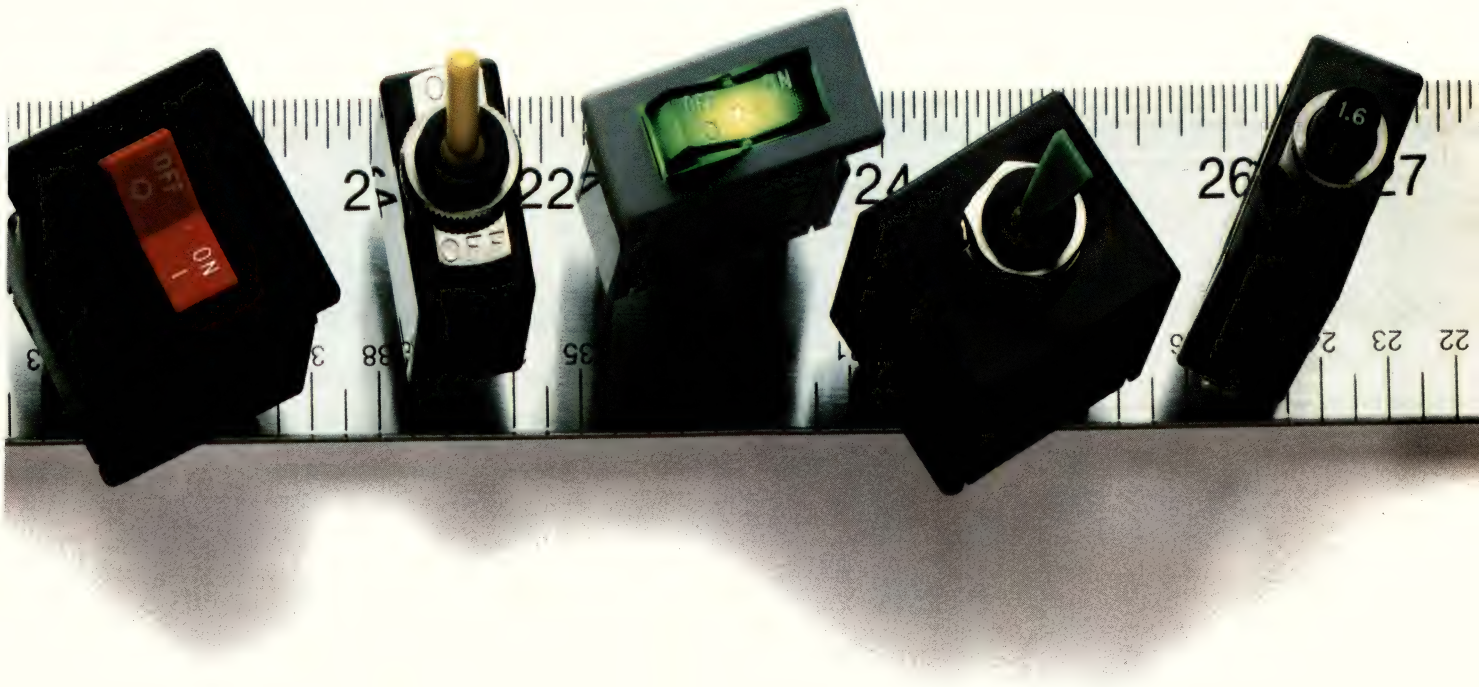
Compact SNAPAK circuit breakers are offered in single- and double-pole designs, in ratings and delays from 0.10 to 15 amperes, in either DC, 50/60 Hz or 400 Hz versions. In addition, a variety of mounting hardware and indicator plates allow vertical or horizontal mounting, with standard "on-off" or "I-O" imprinting for international designs. Reach out to world markets. Contact Airpax Company, Woods Road, Box 520, Cambridge, MD 21613. (301) 228-4600. A division of North American Philips Corporation. In Europe, contact N.V. Airpax S.A., Rue de la Bienvenue, 7-9, B-1070 Bruxelles. Phone: +32-2-526.29.11.

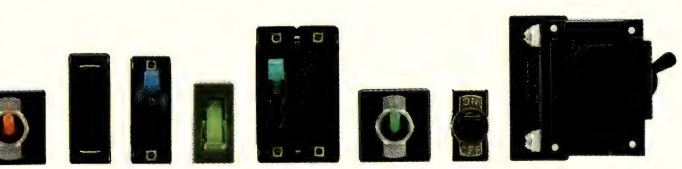




PROTECTION
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For circuit breaker protection that's recognized throughout the world, Airpax has the answer. Our SNAPAK® circuit breakers are UL recognized and CSA certified, and include many versions that are SEV approved, VDE approved, and meet IEC spacing requirements. They offer reliable, magnetic circuit protection in the most compact breaker design worldwide. SNAPAK snap-action ensures greater lifespan, withstanding shock, vibration and temperature fluctuations from -40°C to +85°C. SNAPAK circuit breakers are also trip free, protecting against overload even when forcibly held in the "on" position. Reach out to world markets. Contact Airpax Company, Woods Road, Box 520, Cambridge, MD 21613. (301) 228-4600. A division of North American Philips Corporation. In Europe, contact N.V. Airpax S.A., Rue de la Bienvenue, 7-9, B-1070 Bruxelles. Phone: +32-2-526.29.11.





AIRPAX®
CAMBRIDGE DIVISION



CIRCLE NO 52

ANALOG DEVICES

Ultrafast Voltage Comparators

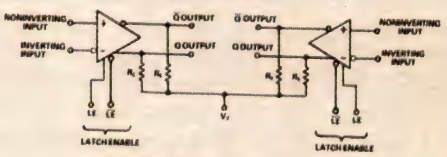
AD96685/AD96687

FEATURES
- 2.5ns Propagation Delay
- Consistent 50ps Propagation Delay Dispersion
- 0.5ns Latch Setup Time
- Stable Transition Zones
- Low Power Dissipation

APPLICATIONS
- High Speed Triggers
- High Speed Line Receivers
- Peak Detectors
- Threshold Detectors



AD96685



THE OUTPUTS ARE OPEN EMITTERS, REQUIRING EXTERNAL PULL DOWN RESISTORS. THESE RESISTORS MAY BE IN THE RANGE OF 50Ω - 200Ω CONNECTED TO −2.0V, OR 200Ω - 2000Ω

AD96687

Functional Block Diagrams

PRODUCT DESCRIPTION

The AD96685 (single) and AD96687 (dual) are ultrafast comparators with short, consistent propagation delays and setup times. Both devices feature an incredible 50ps propagation delay dispersion for any overdrive from 100mV to 1V.

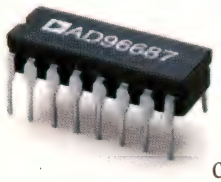
Propagation delays for both units are 2.5ns, and both have stable transition zones. They are manufactured with a high performance bipolar process and have differential inputs and complementary outputs fully compatible with ECL logic levels. Their 30mA output currents are capable of driving 50Ω terminated transmission lines; a latch enable input allows operation in either a sample mode or a track mode.

There are six models of the single AD96685 comparator; three operate over an industrial temperature range of −25°C to +85°C, and the other three are for extended temperatures of −55°C to +125°C. Two of the four models of the dual AD96687 unit operate over industrial temperatures, and the other two are for extended temperatures.

PRODUCT HIGHLIGHTS

1. Propagation delay dispersion of 50ps is the lowest available. Because of this extremely low dispersion, the AD96685 and AD96687 comparators can be used to make very fast, accurate and repeatable measurements despite wide variations in input overdrive; this improves performance for systems using these units.
2. The ultrafast latches allow the comparators to operate in a high speed sample (track)-and-hold mode. When the latch is used properly, input pulses of extremely short duration can be accurately detected and held for additional processing.
3. Since the latch operates on the input state of the comparator, the output state is dependent on the input at the time of the LATCH ENABLE command. This contrasts with strobed comparators, which operate on the output regardless of the input conditions at the time of the strobe.
4. Due to the elegant design of the AD96685 and AD96687 comparators, oscillation-free performance extends over a wide variation of input slew rates and overdrive conditions. This characteristic is not available in many other pin-compatible devices; they often have severe restrictions on how they can be used.

COMPARED TO WHAT'S ON THIS PAGE, NO OTHER COMPARATORS ARE EASIER TO USE.



If the output from your present comparator makes it difficult to use, take a look at the incomparable AD96685 and AD96687. They're the only comparators whose propagation delays remain constant to within 50 picoseconds for any overdrive from 100mV to 1V, so you always get consistent output.

The AD96685 and AD96687 also give you consistent speed, since they switch in 2.5ns, with a setup time of 0.5ns. And they have remarkably stable transition zones, which minimize oscillation.

But speed isn't achieved at the expense of power. The single AD96685 dissipates a mere 118mW, and the dual AD96687 needs just 237mW.

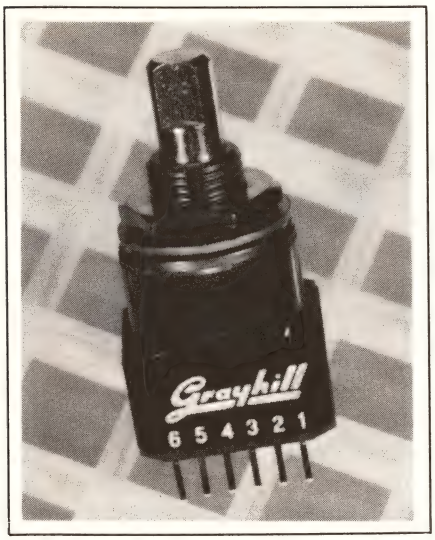
In addition, the AD96685 and AD96687 each have an offset voltage of 1mV typical for a consistent starting point, and an input voltage range of −2.5V to +5V.

Now despite all these advantages, you won't have to change your board design for the AD96685 and AD96687. They're ECL-compatible and drop-in replacements for standard devices. If you'd like a further comparison of the AD96685 and AD96687, call your nearest Analog Devices sales office.

ANALOG DEVICES

Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106; Headquarters: (617) 329-4700; California: (714) 641-9391, (619) 268-4621, (408) 559-2037; Colorado: (719) 590-9952; Maryland: (301) 992-1994; Ohio: (614) 764-8795; Pennsylvania: (215) 643-7790; Texas: (214) 231-5094; Washington: (206) 251-9550; Austria: (222) 885504; Belgium: (3) 237 1672; Denmark: (2) 845800; France: (1) 4687-34-11; Holland: (1620) 81500; Israel: (052) 911415; Italy: (2) 6883831, (2) 6883832, (2) 6883833; Japan: (3) 263-6826; Sweden: (8) 282740; Switzerland: (22) 31 57 60; United Kingdom: (932) 232222; West Germany: (89) 570050

CIRCLE NO 53



PANEL CONTROL

Series 61 rotary switches, in combination with appropriate software, can replace a dedicated keyboard or a touchscreen in measuring or monitoring applications. The switches provide a choice of quadrature 2-bit code, 2-bit counting code, and 3-bit counting-code outputs. You can actuate a switch to provide data entry when the rotary shaft is pushed.

These devices do not use electromechanical contacts for switching. Rather, a rotating disk passes or interrupts light to a pair of phototransistors to provide the coded output. The output can sense the direction of rotation as well as the number of steps. You can design the software to translate the code to cursor movement on a screen or to change the value of a system parameter. The rotary encoder is available with 16 or 24 detent positions. Approximately $20. Delivery, four to six weeks ARO.

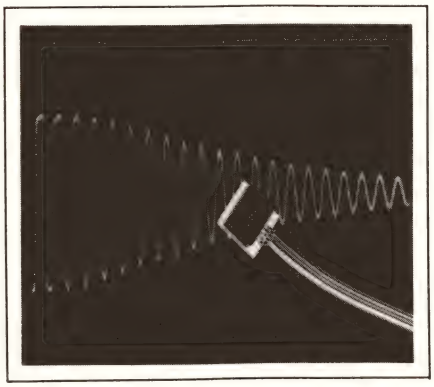
Grayhill Inc, 561 Hillsgrove Ave, LaGrange, IL 60525. Phone (312) 354-1040. TLX 6871375.

Circle No 525

ACCELEROMETER

Model 3021 monitors acceleration, vibration, and shock. It measures 7.9×7.3-mm and is well suited to applications characterized by limited sensor-mounting area.

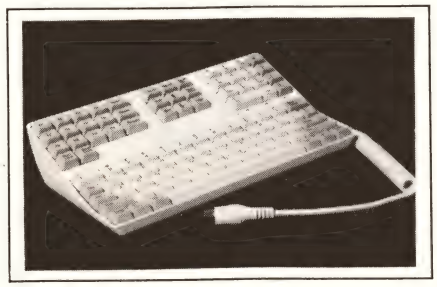
Operating at 5V or 1.5 mA, the



piezoresistive, full-bridge accelerometer provides true dc response and achieves FS sensitivities of more than 50 mV. The sensor has a ±5 to ±100g operating range, a 20× overrange capability, built-in overforce stops, and a 0.707 damping factor (alternate damping ratios are available). Its damping temperature dependence is controlled to better than ±10% over the entire operating range. The unit's Wheatstone bridge provides a true dc response. $87. Delivery, stock to eight weeks ARO.

IC Sensors Inc, 1701 McCarthy Blvd, Milpitas, CA 95035. Phone (408) 432-1800.

Circle No 526



KEYBOARD

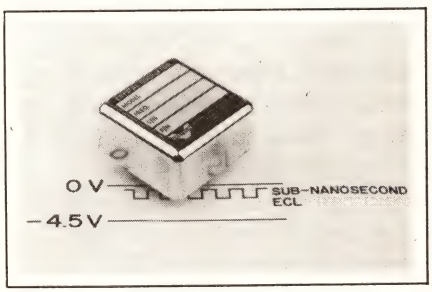
The Microtype Space-Saver keyboard is a direct replacement for the standard 101-key unit sold with most of the IBM PCs or compatibles. Although functionally identical to the standard unit, the vendor's keyboard occupies only 60% as much desk space.

Measuring only 10.75×6.0 in., the keyboard has 100 keys (there's no redundant Enter key) that are arranged so that the number, cursor, and function clusters are located before and above the usual location of the alphanumeric section. This arrangement, in concert with the compression of rows and the absence of borders, provides the space savings but doesn't impede touch typing. In addition, the reduction in eye scan and head and hand movements offers further ergonomic benefits.

The unit features sealed-contact switches and provides quiet tactile response. The switch life specs at 10 million operations. $150.

Mechanical Enterprises Inc, 461 Carlisle Dr, Herndon, VA 22070. Phone (703) 435-9496. FAX 703-453-1837.

Circle No 527



OSCILLATORS

Model CO-233KEQ clock oscillators provide an output at any specified frequency in the 150- to 500-MHz range. The complementary outputs are taken directly from a 100K Series subnanosecond ECL gate.

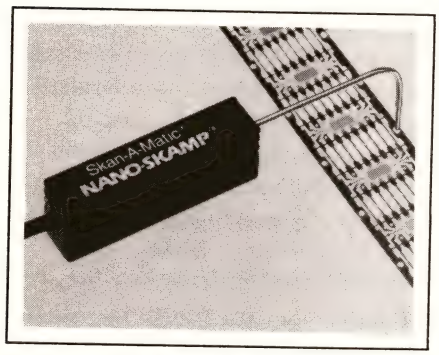
The standard units operate from a −4.5V dc supply but you can specify units that operate with a −5.2V supply. The oscillators are factory set to within ±0.001% of the specified frequency; you can also obtain a version with a frequency adjustment for setting to within ±0.0001% as an option.

Standard oscillators provide a stability of better than ±0.0025% over a 0 to 70°C operating range. You can order units that provide higher stability and wider operating ranges. The units' internal surface-mount construction reduces their package size to 1.5×1.5×0.5 in. From $275. Delivery, 6 to 10 weeks ARO.

Vectron Laboratories Inc, 166 Glover Ave, Norwalk, CT 06850.

Phone (203) 853-4433. TWX 710-468-3796.

Circle No 528



CONTROLLER

The C56 Nano Skamp self-contained photoelectric scanner/amplifier provides sensing and control capability from a single point. The unit, which combines a fiber-optic type snout with a hybrid amplifier, detects targets as small as 0.007 in. from an optimum distance of 0.01 in.

You can obtain the scanner/amplifier in models that operate from 5 or 8V to 25V dc supplies. The vendor ships the units wired for light-energized or dark-energized operation. The internal amplifier features a sensitivity control. An LED indicator allows you to adjust the device without additional equipment.

The amplifier has a fixed amount of hysteresis and provides an open-collector output. The unit's semirigid snout allows you to aim the tip at the target. $138.

Skan-A-Matic Corp, Box S, Elbridge, NY 13060. Phone (315) 689-3961.

Circle No 529

ENCODERS

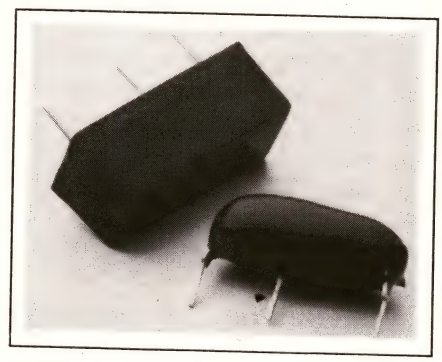
R-2 rotary laser encoders generate both an incremental output (65,536 pulses/revolution) and an absolute output (256 addresses). The units each measure 56-mm in diameter and weigh 300g.

The encoders are designed so that an 8-bit cyclic binary code (gray code) gives each reference position an absolute address. The internal rotary disk has a diffraction grating of 2^{16} slits for the incremental signals as well as 2^8 slits for the reference postion (Z-phase) and for the binary code pattern for absolute signals.

You can order two encoder versions—the R-2A, which has a sinusoidal output, and the R-2L, which has a square-wave output. Both run over 0 to 50°C and require 5V for operation. $1620.

Canon USA Inc, Components Div, 1 Canon Plaza, Lake Success, NY 11042. Phone (516) 488-6700.

Circle No 530



PROTECTORS

You can order Circuit Saver board-level circuit protectors in two types of single in-line packages. Series 150 units come in molded packages that are compatible with autoinsertion applications, whereas Series 155 devices come in conformally coated packages.

Both versions operate in less than 100 μsec and feature an energy-let-through spec of I^2t. The devices' trip points range from 110 to 150% of rated current.

Ratings for the two lines of devices range from 50 to 1000 mA and 5 to 50V dc. The units will automatically reset when you remove the fault condition. You can also obtain the protectors with an LED trip-indicator (Series 156) and with 2, 3, and 4A current ratings (Series 300). $2.78 (1000).

Inresco Inc, 654 Ocean Rd, Point Pleasant, NJ 08742. Phone (201) 892-5881.

Circle No 531



OSCILLATORS

MSCO series surface-mount crystal clock oscillators have an output frequency in the 0.1 to 35-MHz range. Available on tape and reel, the units withstand 215 or 253°C for 10 seconds to 5 minutes during the vapor-phase reflow process or 260°C for 10 sec during wave soldering.

Designed for use in harsh environment applications, the oscillators come in leadless, hermetically sealed ceramic chip carriers that measure 0.35×0.55×0.11 in. They feature a 5000g shock rating, as well as frequency stabilities that range to ±100 ppm over the 0 to 70°C operating range. The rise and fall times range from 6 to 8 nsec. The oscillators operate from a 5V supply. $9 to $11 (1000). Delivery, four to six weeks ARO.

ETA Industries Inc, 35 East 21st St, New York, NY 10010. Phone (212) 505-5340.

Circle No 532

SWITCHES

GB pushbutton switches are well suited for applications where size and weight are the critical considerations. Units are available in spdt and dpdt models rated for 0.4VA at 28V dc max. All units spec a 100,000 actuation lifetime.

Each of the switches features a patented, gold-plated, sliding twin crossbar (STC) contact mechanism. Since the STC is sealed, the switches are impervious to contaminants. The STC's sealed construction also allows the units to withstand automated soldering and washing operations.

HP's new optically programmable SmartWand barcode reader makes it easy to add barcode scanning capability to most host systems.

The SmartWand reader cuts your design-in time to a matter of hours. And it eliminates the need for extensive decode and debug experience. All it takes is a 5V serial interface. Just plug in the wand and you're in business.

And since the wand does its own decoding, you can easily program it to read seven different barcode symbologies. Or ask it to convert any of these codes to Code 39 for decoding by older systems.

Plus it works in intense artificial light, direct sunshine and rain. And it's available in special versions for high- and low-resolution applications. All in a low-power industrial-wand package with no footprint.

The SmartWand barcode reader's price is easy to read too. Under $250* in 100 quantities. To order, contact your authorized HP distributor today. In the U.S.: Almac Electronics, Hall-Mark, Hamilton/Avnet, or Schweber. In Canada: Hamilton/Avnet or Zentronics, Ltd.

HEWLETT PACKARD

Easy reading.



*U.S. list prices
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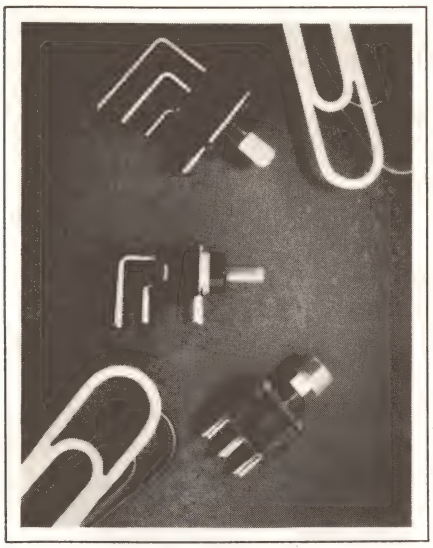
If you purchase discrete semiconductors directly from Unitrode and any of those parts have electrical or mechanical failures within 60 days of delivery, just call us for an RMA. We'll take back the unused, failed parts and replace them free. **You will pay only for the parts that passed the first time around.**

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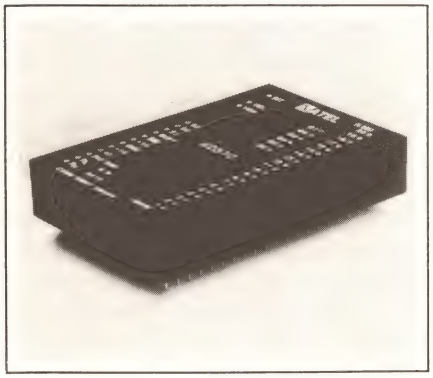
CIRCLE NO 55



Molded-in terminals provide an extra measure of protection against flux, dust, and other contaminants. The antistatic resin employed for the switch housing and base prevents static electricity charges from reaching the contacts. The switches are available with straight, right-angle, and vertical mounting terminations. All of them conform to 0.1×0.1-in. board grid spacing. $2.66 (100).

NKK Switches, 14415 North Scottsdale Rd, Scottsdale, AZ 85260. Phone (602) 991-0942.

Circle No 533



CONVERTER

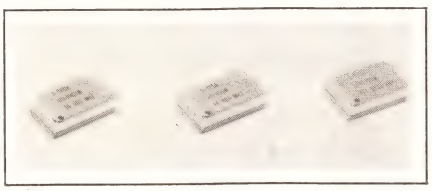
Model 570 is a tracking synchro/digital converter with zero velocity-lag error. The 20-bit unit provides a 6 arc-sec accuracy, 1.24 arc-sec resolution, and a 720°/sec tracking rate.

Other features include a 180°, antifalse lockup circuit, a reference synthesizer, and an analog velocity output. The digital inputs and outputs are TTL compatible. The common-mode rejection exceeds 70 dB and the isolation for dc common-mode voltages ranges as high as 300V peak on all synchro and reference input lines.

The 570 has a built-in-test feature that provides a logic 1 when the tracking error exceeds ±1°. Units are available in both commercial and military versions. From $2400. Delivery, six to eight weeks ARO.

Natel Engineering Co Inc, 4550 Runway St, Simi Valley, CA 93063. Phone (805) 581-3950. TWX 910-494-1959.

Circle No 534



OSCILLATORS

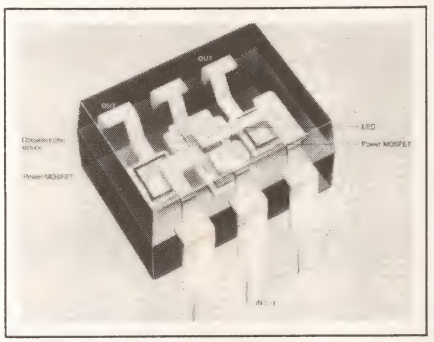
QT6V and QT41V Series military grade hybrid voltage-controlled clock oscillators are available with outputs in the 1 kHz to 55 MHz range. The deviation specs at ±100 ppm typ for a range of 0 to 5V. Larger deviations are available as an option.

The oscillators feature a modulation bandwidth capability that ranges to 10 kHz. They have a ±25 ppm stability spec over the −20 to +70°C operating range. Their output duty cycle equals 50±10% typ.

The 6 and 41V oscillators are available in 4- and 14-pin hermetically sealed, corrosion-resistant DIPs, respectively. The power requirements spec at 5V at 25 mA. Oscillators are offered with TTL, HCMOS, or sine-wave outputs. Military screening is available. For units with outputs in the 8- to 27-MHz range, $42.16 (100). Delivery, 12 weeks ARO.

Q-Tech Corp, 10150 W Jefferson Blvd, Culver City, CA 90232. Phone (213) 836-7900. TLX 696140.

Circle No 535



RELAYS

Housed in miniature 6-pin DIPs that measure 0.369×0.252×0.153 in., Photo-MOS relays combine both electromechanical and solid-state technologies

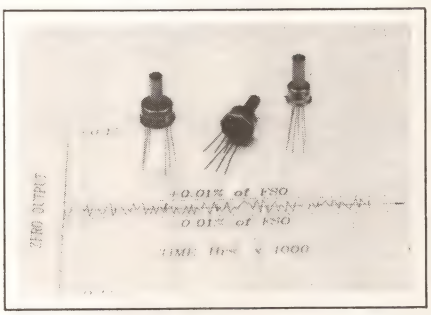
Each relay uses an optoelectronic element to directly drive a power MOSFET—eliminating the need for a power supply. The optoelectronic device converts received light to voltage, which drives the power MOSFET to switch the load on and off.

The relays will control 150-mA loads at 400V peak. The input-to-output isolation specs at 1500V ac min.

You can mount the devices at any angle. And since the devices are unaffected by magnetic fields, you can mount the relays in close proximity. $4.50 (500). Delivery, 8 to 12 weeks ARO.

Aromat Corp, 629 Central Ave, New Providence, NJ 07974. Phone (201) 464-3550.

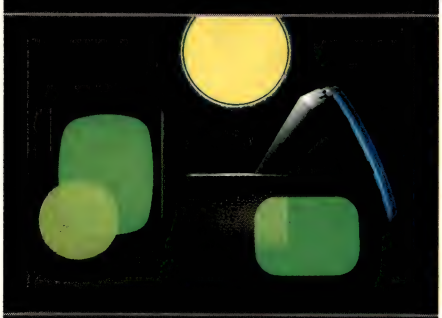
Circle No 536



PRESSURE SENSORS

Housed in TO-8 and TO-5 packages, NPH Series pressure sensors feature a 1-year, 0-output stability of less than 1% of FS output (FSO)

CUSTOM
X-Y MONITORS
OFF-THE-SHELF



X-Y monitors for simulation, training, ATE, CAE/CAD/CAM or radar repeating. XKD can provide high performance XM-300 series monchrome stroke writers in a broad range of sizes, shapes, and phosphors without the usual long delivery times required for custom projects.

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CIRCLE NO 56

Components

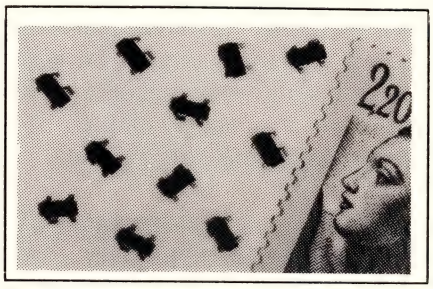
max. The typical short-term stability specs at ±0.01% over thousands of hours.

The sensors' FS pressure ranges from 30k to 1700k Pascal (approximately, 5 to 250 psi) in a gauge, absolute, or differential version. Other key specs include a static accuracy of ±0.1% FSO (combined linearity, hysteresis, and repeatability), 100 mV FSO for a 1.5 mA input, ±0.1% FSO thermal hysteresis, and an overpressure capability ranging to four times the rated pressure. The sensors reach 0.1% of their steady-state output within 10 seconds after the power is turned on.

These units are media compatible with noncorrosive gases and moist air. A 3/16-in. pressure port is standard. The integral temperature compensation is available as an option. $9.75.

NovaSensor, 1055 Mission Court, Fremont, CA 94539. Phone (415) 490-9100. TLX 990010.

Circle No 537



RESISTIVE DIVIDERS

RMKM-143 Series surface-mount resistive dividers contain two identical-value, series-connected resistors, which track each other to within 5 ppm/°C. The dividers' absolute TC is ±10 ppm/°C over the 0 to 70°C range and ±15 ppm/°C over the −55 to +125°C range.

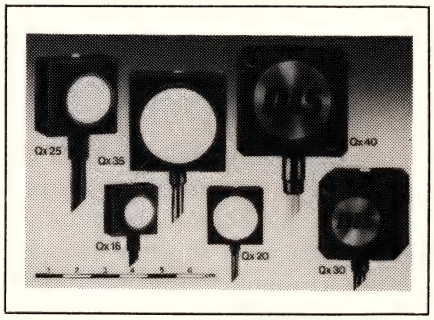
The dividers provide impedance values between 1 kΩ and 249 kΩ and tolerances between ±0.1% and ±2.0%. Corresponding ratio tolerances range from 0.05% to 0.5%. Long-term stability is less than 500 ppm over a period of 2000 hours at 70°C. The dividers provide 125 mW at 70 °C. The noise index is −45 dB typ (−35 dB worst case). $3.65 (1000).

Sfernice, 199 Blvd de la Madeleine, 06021 Nice Cedex, France. Phone 93446262. TLX: 470261.

Circle No 720

Ohmtek, 2160 Liberty Dr, Niagara Falls, NY 14304. Phone (716) 283-4025. TWX: 710-524-1653.

Circle No 721



PROXIMITY SWITCHES

Instead of using a conventional cylindrical threaded housing, Quadro-Prox proximity switches feature a rectangular housing with four fixing-bolt holes. Several of the models have elongated mounting holes to facilitate lateral adjustment. This housing and mounting method, according to the vendor, provides greater environmental protection and easier adjustment. The switches' sensors and their electronics are embedded in silicon rubber to improve the switches' resistance to vibrations and the ingress of water and chemicals. Standard housing sizes range from 10×10×7 mm to 40×40×25 mm. The housings come in epoxy resin, aluminum, or stainless steel. Switching distances range from 1 to 20 mm. Gld 45 to 60 (1000).

Dewit Industrial Sensors bv, Box 202, 3440 AE Woerden, The Netherlands. Phone (03480) 13154. FAX (034) 802-2352.

Circle No 722

ROTARY ENCODER

The Saturn absolute, positional encoder maintains its 24-bit output

Text continued on pg 109

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CIRCLE NO 57

IRC SURFACE-MOUNT RESISTIVE PRODUCTS OPEN-UP A NEW WORLD OF APPLICATIONS.

Standard and custom devices — one source for all

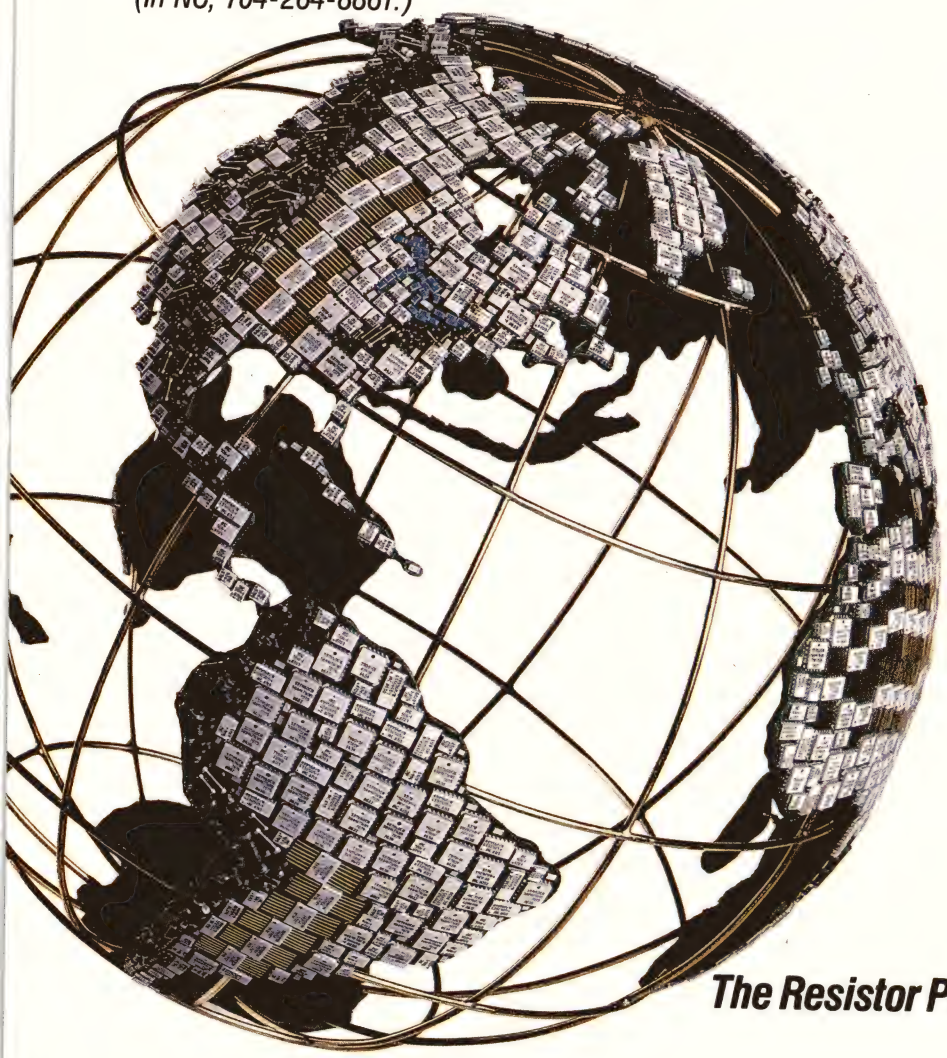
From one source you can get virtually every type of discrete resistor and resistor network that can be produced in a surface-mount configuration. All fabricated with proven IRC materials and resistor elements — so reliable performance is a sure thing.

IRC was one of the first to offer surface-mount power wirewounds, and our RG Glaze® power chips are the smallest available.

Our TaNFilm® technology produces resistor networks with exceptional stability, tight tolerances, close TCR tracking, and low noise. These networks, and our chip resistors, also meet or exceed military requirements.

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SURFACE-MOUNT RESISTOR NETWORK
50 Ω TO 100K Ω, TOL. TO ± .02%, TCR TRACKING TO 2 ppm/°C



SMALL-OUTLINE RESISTOR NETWORK
50 Ω TO 100K Ω, TOL. TO ± .02%, TC TO ± 25 ppm/°C



PRECISION FLAT CHIP
50 Ω TO 50K Ω, TOL. TO ± 0.1%, TC TO ± 25 ppm/°C



POWER-CHIP RESISTOR
1 Ω TO 10M Ω, TOL. TO ± .5%, 1/4 TO 2 W



SEMI-PRECISION WIREWOUND
.1 Ω TO 1.5K Ω, TOL. TO ± 0.25%, 3 W



GENERAL PURPOSE CHIPS
10 Ω TO 2.2M Ω, TOL. ± 1% TO 5% 1/8 AND 1/10 W

LPW SURFACE-MOUNT RESISTOR
.01 Ω TO .5 Ω, TOL. ± 1, 2, & 5% 2 W



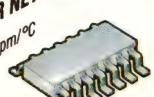
TaNTee SUBMINIATURE DUAL NETWORK
10 Ω TO 10K Ω, TOL. TO ± .1%, 1/4 W



FLAT PACK RESISTOR NETWORK
50 Ω TO 100K Ω, TOL. TO ± .02%, MIL-R-83401 CHARACTERISTIC H



DIP GULL-WING RESISTOR NETWORK
TOL. TO ± 0.1% STD. TC TO ± 25 ppm/°C (Available 4th quarter 1987)



The Resistor People

IRC

A member of the Crystalate Group

CIRCLE NO 58

resolution while rotating at a speed of 3000 rms. A resolution of 12 bits/revolution for 4096 revolutions provides a total 24-bit output resolution. The encoder comes sealed to IP65 requirements and operates over a temperature range of −10 to +80 °C. Its serial output drives 50m coaxial cable max. Interface circuitry, which comes on a Eurocard-size pc board, processes the encoder output to produce either a binary or Graycode, TTL-level, parallel output. In addition, the interface card lets you direct the rotation required to produce an ascending output code, set a null point for the encoder, and reset it. The encoder and interface card require a 24V±25% dc supply. Both encoder and interface card, DM 1500.

Hengstler GmbH, Postfach 100, 7209 Aldingen 1, West Germany. Phone (07424) 891. TLX: 760422.

Circle No 723

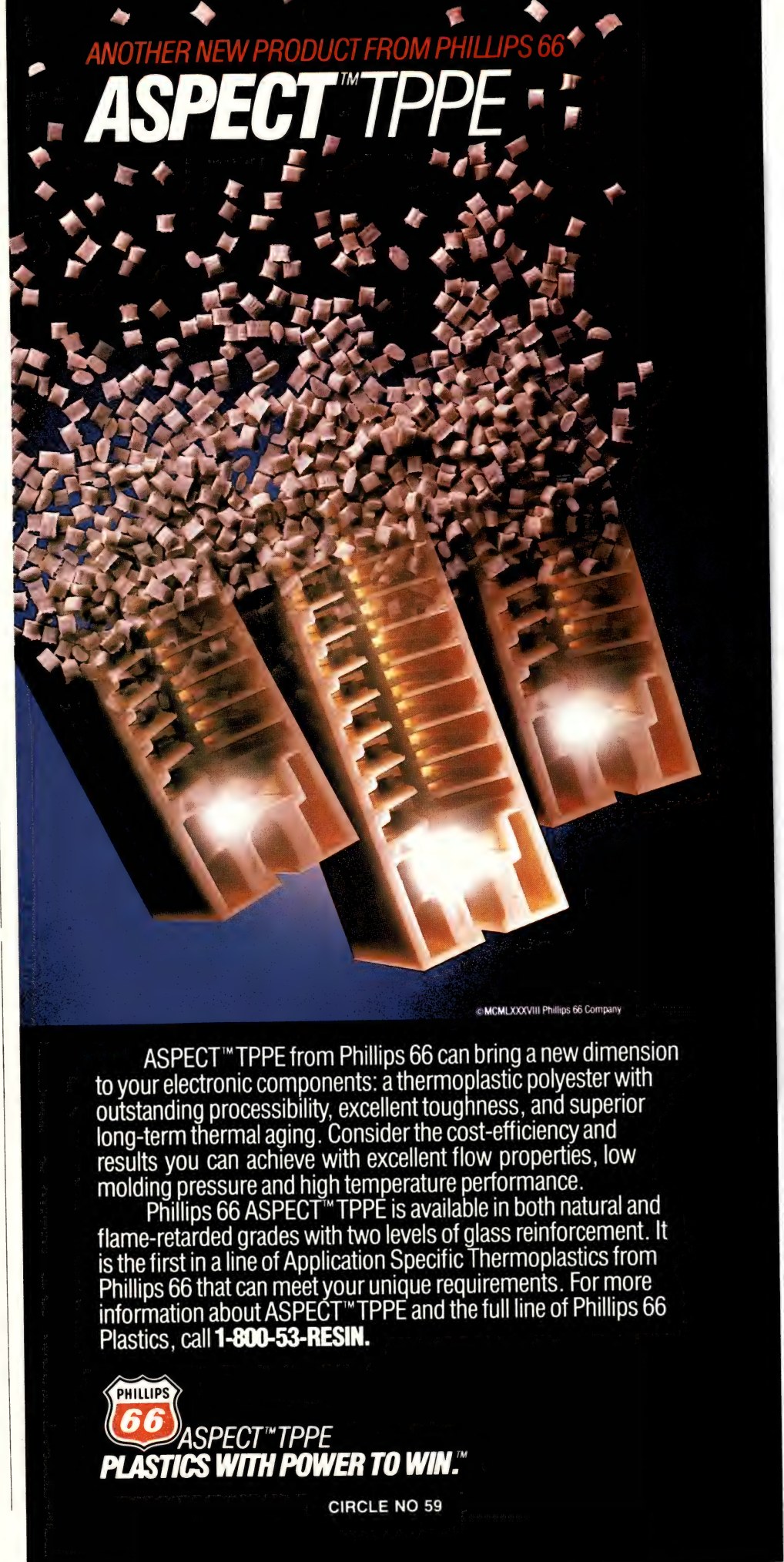
Hecon Corp, 15 Meridian Rd, Eatontown, NJ 07724. Phone (201) 542-9200. TLX: 132457.

Circle No 724

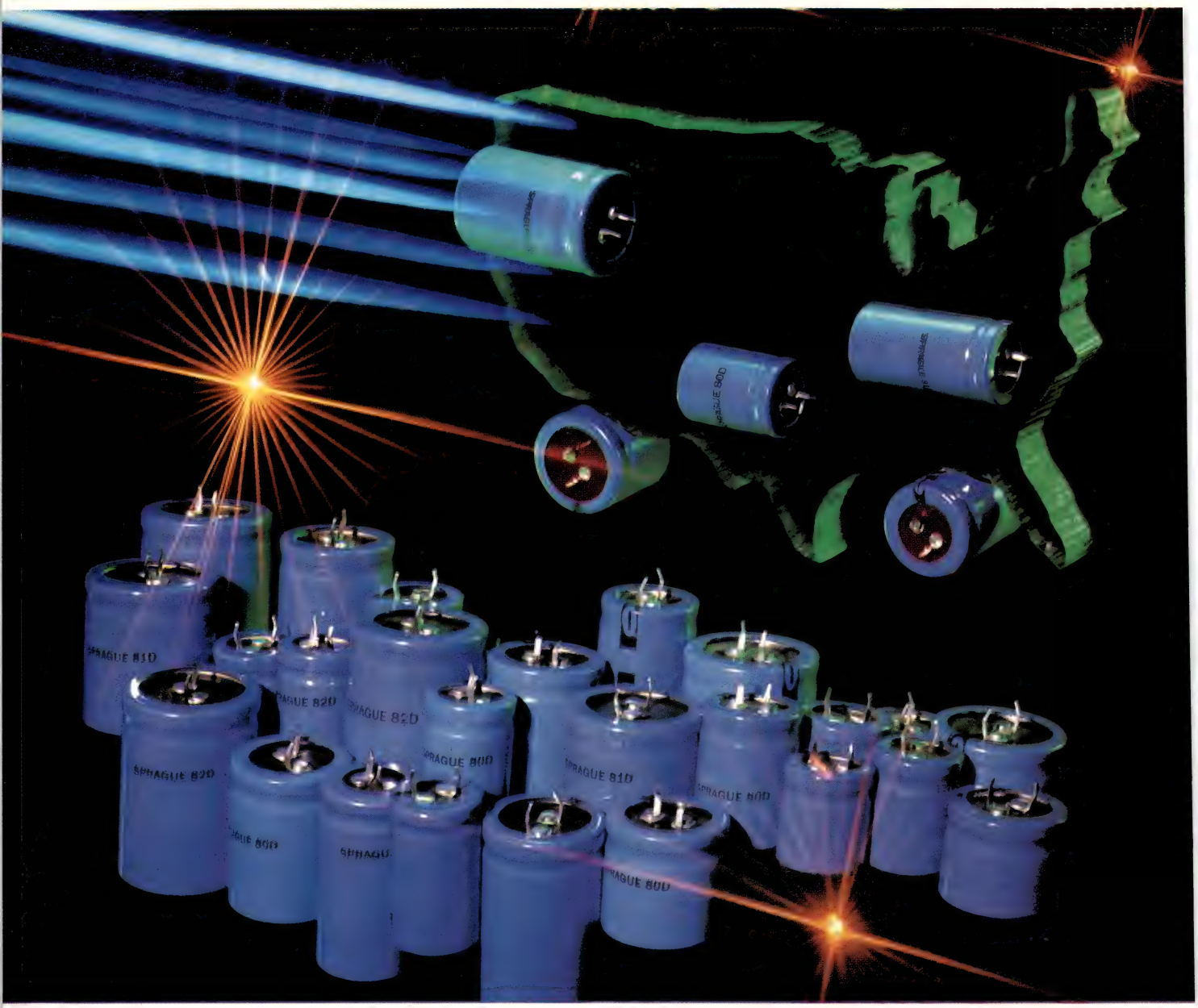
1553B BUS COUPLERS

The 50151/1 and 50151/3 1553B bus couplers provide one and three bus stubs, respectively. Each transformer-isolated bus stub features integral 1W-isolation resistors, providing the stub with dc isolation from the 1553B bus, as well as common-mode noise rejection and short-circuit protection. Both bus couplers are available with either Amphenol 711 or Amphenol 715 connectors, or you can request other connector options. The couplers are housed in fully screened, chassis-mounted packages with 1553B bus connectors at each end and the stub connectors on one side. Model 50151/1 with type 715 connectors £135; with type 711 connectors £160. Model 50151/3 with type 715 connectors £240; with type 711 connectors £275 (100).

Newport Components Ltd, Tanners Drive, Blakelands North,



NO-WAIT ALUMINUMS.



4SE-611

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Economy, high-performance, high-reliability, and quick delivery are the hallmarks of Sprague's Type 80D, 81D, 82D snap-mount aluminum capacitor family. Designed for switched-mode power supply input and output filtering and general-purpose applications, these caps feature high capacitance in small case sizes, low ESR, and high ripple current capability. And since they're manufactured in the U.S., you're guaranteed fast delivery. The 80D family offers voltage ratings from 6.3 to 400 WVDC, and capacitance values from 33 μF to 56,000 μF. Capacitance tolerance of Type 80D is −10%, +30%, and for Type 81D and 82D caps ±20%. The operating temperature range of Type 81D is −40°C to +105°C. For Type 80D and 82D, −40°C to +85°C. Snap-lock terminals assure secure mounting on printed wiring boards. For Data Sheets 3156B, 3162 and 3163 on our no-wait aluminums, write to Technical Literature Service, Sprague Electric Company, P.O. Box 9102, Mansfield, MA 02048-9102.

CIRCLE NO 60

SPRAGUE®
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Milton Keynes MK14 5NA, UK. Phone (0908) 615232. TLX: 825621.
Circle No 726

OSCILLATORS

The outputs of the QC6111 and the QC6112 surface-mount crystal oscillators are TTL/CMOS and TTL compatible, respectively. Output frequencies range from 875 kHz to 28 MHz. In addition, the oscillators have an operating-environment specification that meets or exceeds the requirements of MIL-0-55310/19. The products are housed in 40-pin, ceramic chip-carrier packages. They operate over a temperature range of −55 to +125°C and have a frequency tolerance (relative to their nominal frequency) of ±100 ppm. Around £40 (100).

Salford Electrical Instruments Ltd, Times Mill, Heywood, Lancashire OL10 4NE, UK. Phone (0706) 67501. TLX 635106.

Circle No 725

RF POWER MODULES

The BGY49A and the BGY49B, 20W output-stage modules for 400-MHz cellular/mobile radios, offer a 30-dB power control range. They ensure that base stations don't get overdriven when vehicles are close to the base station. The BGY49A operates over a frequency range of 400 to 440 MHz, and the BGY49B operates over a 440- to 470-MHz range. Both units have a drive requirement of 150 mW max and achieve an overall efficiency of 35%. They operate from 12.5V supplies and withstand an overload VSWR of 50:1 for short periods under maximum output power and supply voltage. The modules are encapsulated in 52.5×19.7×8.1-mm plastic. Around gld 125; delivery, two to three months ARO.

Philips, Components Div, Box 523, 5600 AM Eindhoven, The Netherlands. Phone (040) 757189. TLX 51573.

Circle No 727

Amperex Corp, 230 Duffy Ave, Hicksville, NY 11802. Phone (516) 931-6200.

Circle No 728

FIBER POLARIZER

This single-mode, fiber-optic polarizer provides an extinction ratio of greater than 40 dB and an insertion loss of less than 0.5 dB. It works by coupling light in the unwanted polarization state into a plasma wave that is supported on a thin metallic film deposited onto the fiber. The operating-temperature range is −40 to +85°C; the extinction ratio varies by ±2 dB. The polarizer comes in a 45×20×10-mm package with 1m fiber pigtails.



LLS electroluminescent (EL) lamps offer the designer a surface illumination alternative far superior to incandescent or other conventional light sources. And, whereas other makes of EL lamps may offer some of our product features, comparative tests prove that for long life, brightness, uniform light diffusion, color stability, resistance to moisture, heat, vibration and shock, no other EL lamps can match ours.

Thin, flexible and lightweight– Many shapes, sizes and colors
These rugged, solid-state EL lamps provide cool, uniform light across the entire lamp surface, eliminating the need for sockets, bulbs, diffusers and reflectors. Power consumption is small due to low current demand. A thin profile (.032") permits high density packaging; and with IC-style leads available, lamps are compatible with PCBs. Although stocked in rectangular shapes for immediate delivery, we can design EL lamps in a variety of custom shapes and sizes including complex forms with multiple holes and cutouts. Available with pressure-sensitive adhesive on front or rear surfaces.



If you'd like a copy of our brochure, or have questions regarding EL applications, just call, write or TWX the LLS Marketing Department.

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Tel. (603) 448-3444 TWX 710-366-0607
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CIRCLE NO 61

"EDN MAGAZINE'S PRODUCT MART SECTION IS HELPING US BECOME A LEADER IN OUR MARKETPLACE."

Raymond J. Schnorr
Vice President of Marketing
ACCEL Technologies

As Vice President of Marketing, Ray Schnorr is responsible for marketing ACCEL Technologies' affordable, professional software that meets the design needs of electrical engineers. He operates on a fixed budget and demands results. "When it comes to buying media, I'm interested in two things: performance and price. With EDN's Product Mart section, I pull high-volume sales leads and meet my budget," says Schnorr.

In nineteen months, ACCEL has sold 5000 software packages to 3000 sites. "Our ⅛-page Product Mart ads in EDN magazine are allowing us to reach our target audience." And Schnorr sees more for EDN and ACCEL. "We have significant growth plans for ACCEL, and running bigger ads in EDN will be part of the strategy to get there.

"The power and prestige of EDN is helping us grow into a leading design software company."

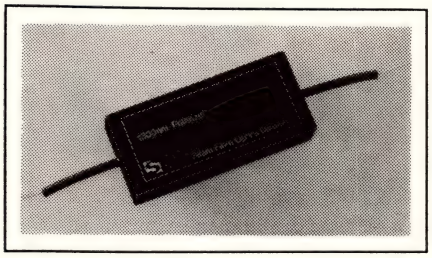




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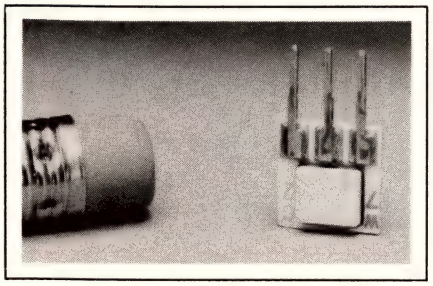
Where Advertising Works



Available versions provide 1300- and 1550-nm wavelengths. Around £800.

Sifam Ltd, Fibre Optics Div, Woodland Rd, Torquay, Devon TQ2 7AY, UK. Phone (0803) 63822. TLX: 42864.

Circle No 729



POSITION SENSORS

SS83CA digital Hall-effect position sensors operate over a −55 to +150°C range. At 25°C, the typical operate point is +15 gauss and the release point is −15 gauss. The maximum rise and fall time equals 1.5 μsec.

These sensors are bipolar magnetic devices with operating speeds ranging to over 100 kHz. The sensors offer reverse voltage protection, a −28 to +28V dc supply voltage range, and a symmetrical duty-cycle output over the operating range. The magnetic specifications provide a high degree of repeatability and interchangeability. The sensor's internal thin-film resistors are laser-trimmed to achieve accurate operate and release points.

The sensors come in a 0.3×0.3-in. ceramic package with a ceramic cap. The 4-pin package is designed for pc-board mounting. $0.80 (50,000).

Micro Switch, 11 West Spring St, Freeport, IL 61032. Phone (815) 235-6600.

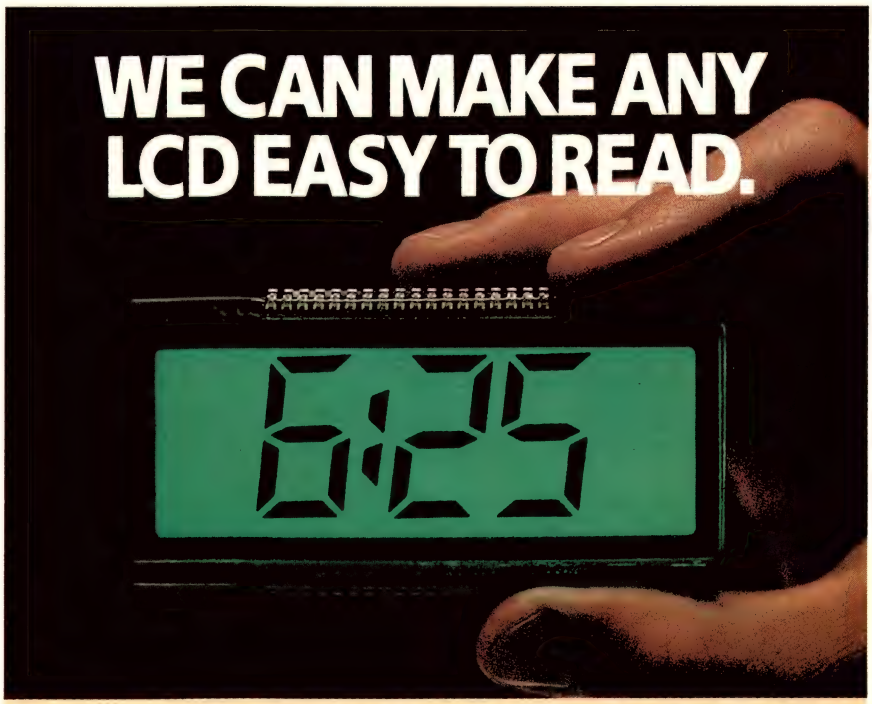
Circle No 538

SWITCHES

E Series switches comprise 3-pole sealed toggle, rocker, and lever-handle devices. All will withstand wave soldering and cleaning processes without requiring any special handling.

Five 3-spdt switching functions are available, including momentary. The switches' silver contacts are rated for 5A at 125V ac/28V dc or 2A at 250V ac. Their gold contacts have a 0.4V A rating at 20V ac or dc max. Their electrical life specs at 30,000 cycles. Their Insulation resistance and dielectric strength equal $10^9\Omega$ min 1000V rms, respectively.

The switches' features include welded glass-filled nylon housings



Our thin, flexible electroluminescent lamps dramatically improve LCD readout by providing higher contrast and better visibility. A thin profile (.032") allows high density packaging, and pressure-sensitive adhesive can be supplied on front or rear surfaces for rapid assembly.

Uniform, cool light source in many shapes, sizes and colors
Our backlighting ELs emit even illumination across the entire lamp surface. They also eliminate the need for sockets, bulbs, diffusers or reflectors. Lamps are usually supplied in rectangular shapes, but we can create many custom shapes and sizes including complex forms with multiple holes and cutouts. With IC-style leads, lamps are compatible with PCB assembly. Eight standard colors are available and custom colors can be created.

If you'd like more information relating to LCD applications, just call, write or TWX the LLS Marketing Department.



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Which switch would you pick for reliability?



47 pieces

Conventional rotary selector switch 1-pole, 11-position



9 pieces

CTS insert molded rotary selector switch 1-pole, 11-position

It is very apparent that the CTS rotary selector switch—*with only* 19% *as many separate parts* as an ordinary switch—offers greater stability and precision switching even under punishing use or severe shock and vibration. Insert molding locks every CTS terminal in place for positive, precise switching—even after thousands of operations.

Take another look at this picture of reliable performance. Compare the many tiny, fragile pieces in an ordinary switch that can become mis-aligned and cause problems in the field. Remember the simple, solid construction of a CTS rotary. You can't make a mistake when you specify the switch that's *built to be most reliable.*

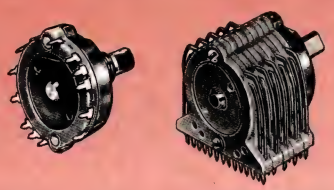
For a complete catalog of reliable CTS rotary selector switches—both stock and custom, call your CTS sales engineer or write: CTS Corporation, Elkhart Division, 1142 W. Beardsley Ave., Elkhart, IN 46514. Phone: (219) 295-3575. ***West of Mississippi River:*** CTS Corporation,* Paso Robles Division, 500 Linne Rd., Paso Robles, CA 93446. Phone: (805) 238-0350.



*In Calif. dba CTS Electronics Corporation.

CIRCLE NO 246

CTS offers thousands of PC board rotary switch variations—all with insert molded reliability



Select from a wide variety of shorting, non-shorting or mixed circuitry—as well as a range of index assemblies and wafer constructions for either perpendicular or parallel PCB mounting. Also available with AC power switches and variable resistors.

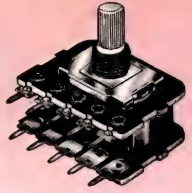
Call TOLL FREE 1-800-982-0030 for name and location of nearest CTS Sales Engineer

CTS® MEANS RELIABILITY

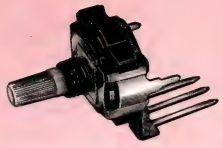
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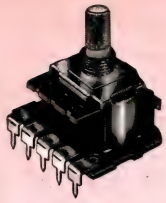
Series 288 16 mm
Electronic Tuner Switch
Phone: (219) 295-3575
CIRCLE NO 65



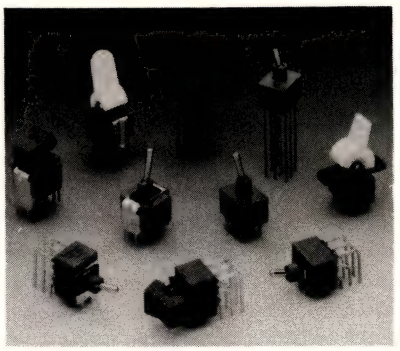
Series 288 16 mm
Rotary Selector Switch
Phone: (219) 295-3575
CIRCLE NO 243



Series 288 16 mm
Two-bit Shaft Encoder
Phone: (219) 295-3575
CIRCLE NO 244



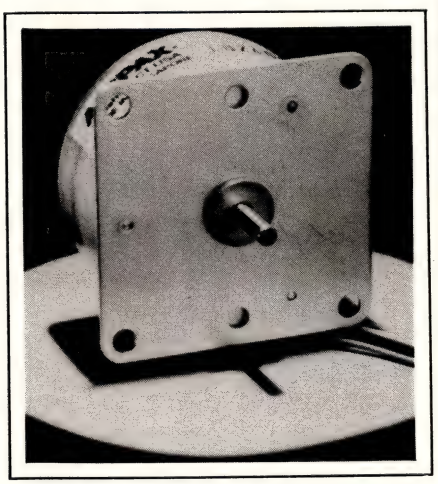
Series 288 16 mm
Spring Return Switch
Phone: (219) 295-3575
CIRCLE NO 245



(94V-0 rating), epoxy terminal seals, and internal O-ring actuator seals. The actuator options include three toggle styles and six different rocker and lever handles. From $6.17 (1000). Delivery, four to five weeks ARO.

C&K Components Inc, 15 Riverdale Ave, Newton, MA 02158. Phone (617) 964-6400. TLX 922544.

Circle No 539



STEPPER MOTORS

L82400 42-mm stepper motors satisfy requirements for global products. The PM-type motors have holding torque ranging to 12.4 oz-in., and a 1.25×10^{-3}g-m^2 rotor moment of inertia.

The motors have a 7.5° step angle —48 steps/revolution. A ±0.5 noncumulative step angle tolerance ensures accurate rotary positioning performance.

Permanently lubricated bronze sleeve bearings are standard. You can also obtain a unipolar or a bipolar model that operates from either 5 or 12V dc. Bipolar model, $7.65 (500). Delivery, 4 to 12 weeks ARO.

Airpax Co, West Johnson Ave, Cheshire, CT 06410. Phone (203) 272-0301. FAX 203-271-1482.

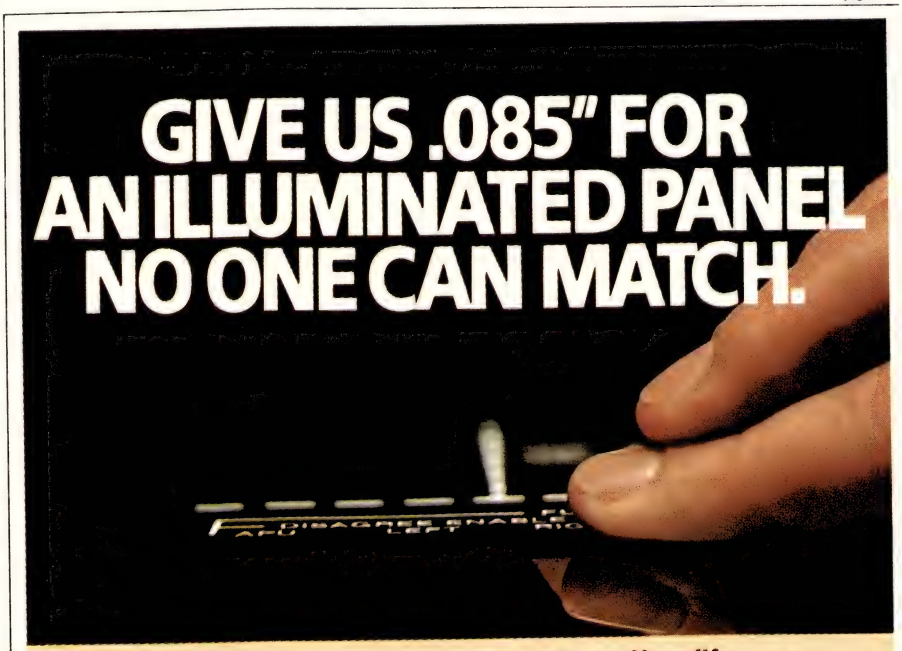
Circle No 540

KEYPADS

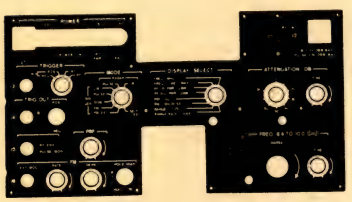
These conductive and nonconductive short-travel switches include custom keypads or standard 3×4 telephone-type keypads. Made of silicone rubber, the pads are resistant to ozone, corrosion, contamination, and other severe environmental conditions.

The nonconductive switches eliminate the need for pc boards. They incorporate a rubber keypad, which

Text continued on pg 118



At only .085" thick, our new fiberglass electroluminescent panels are designed to replace lightplates and traditional metal plates that may not presently be illuminated. Our thin .085" panels weigh 40% less than a typical .220" plexiglass panel, and with an expansion coefficient equal to aluminum, the lamps are ideal for surface-mount applications.



LLS electroluminescent panel

As the pioneer developers of EL lamps, as well as the process of encapsulation, we have combined the uniform, cool surface illumination of EL with the strength of fiberglass to create a new standard for panels.

Durability and long life luminescence

LLS EL lamps eliminate the need for sockets, bulbs, diffusers or reflectors, and add no heat to the assembly. This, together with their long life and availability in many colors, make them the intelligent choice for panel illumination – far superior to LEDs or incandescent bulbs. We create panels (including standard .220" plexiglass) in almost any shape and size, as well as complex designs with multiple holes and cutouts. Lamps can be filtered to comply to ANVIS or other military specifications, or to your design requirements.

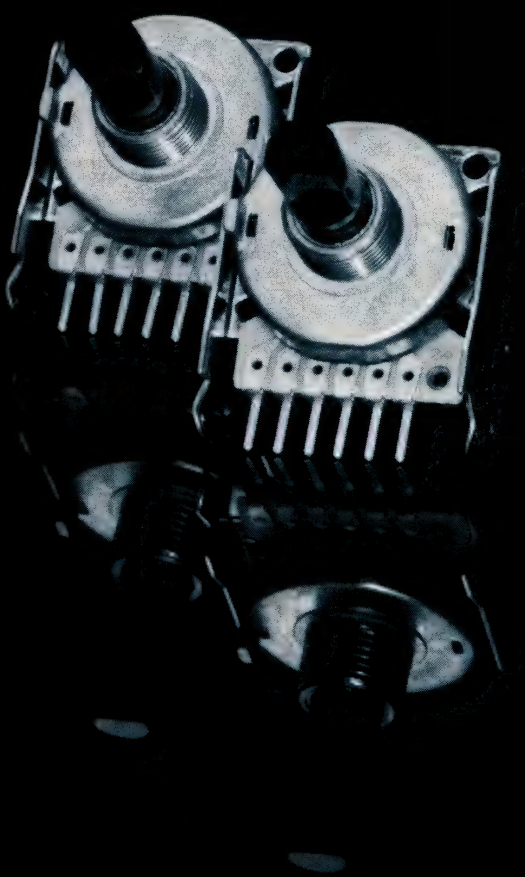
If you'd like a copy of our brochure, or have questions regarding panel applications, just call, write or TWX the LLS Marketing Department.

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CIRCLE NO 63

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CIRCLE NO 66

BOURNS



A New Degree of SMT Trimmer Processability. 300°C.

The new 3314 from Bourns Trimpot beats the heat of virtually any SMD solder reflow process. Here is the first sealed trimmer designed to withstand TOTAL IMMERSION during dual wave soldering. In fact, in tests at 300°C...where conventional SMD trimmers failed...every Bourns 3314 met all electrical performance specifications.

Now with the Model 3314, you can place trimmers on both sides of the PCB, no matter which SMD soldering process you use--vapor phase, infrared, or dual wave!

AND WE'RE JUST GETTING WARMED UP

The 3314 includes many features that make it the hottest choice in SMT trimmers:

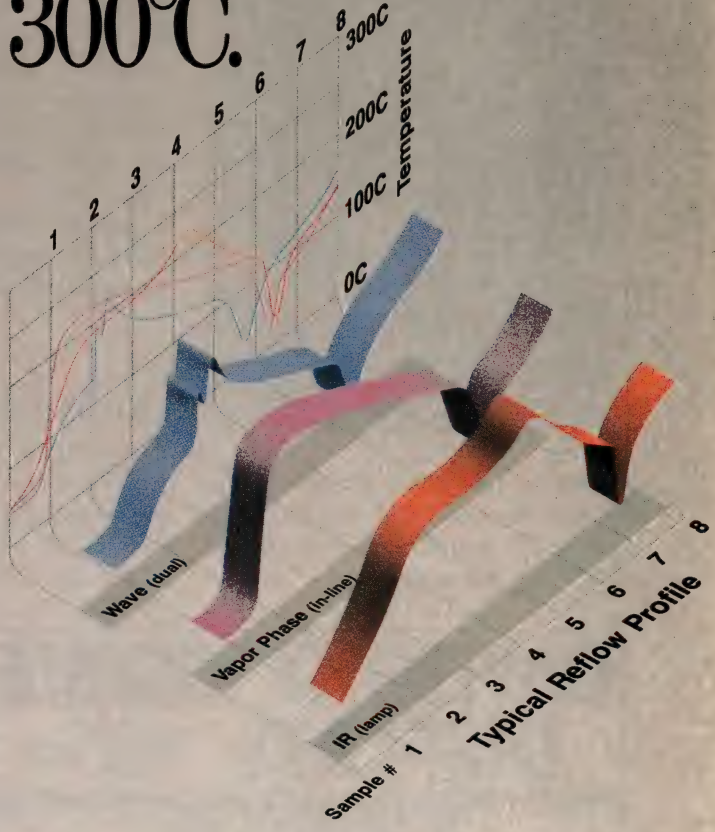
-hoe tip wiper design that maintains uniform wiper to element footprints, which lower contact resistance variation and improve stability

-rugged unitized construction retains higher stop strength and constant rotational torque after SMD processing

-miniaturized 4mm design allows for higher component density



Have we hit your hot button? For a new data guide on 3314, simply contact your local Bourns Trimpot rep today!



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THERE'S STILL NO EQUIVALENT

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serves as the switch actuator and is positioned over a 3-layer membrane panel. The membrane uses conductive silver ink traces.

In the conductive keypads, a carbon-impregnated silicone pill is molded on the underside of the rubber dome to accomplish the switching function. The conductive switch mounts onto a glass epoxy pc board.

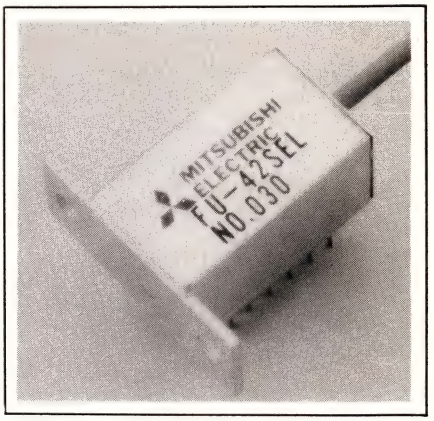
The molded translucent or opaque switches come with custom color options, LED backlighting, and alphanumeric or symbolic legends screened onto rubber or plastic key caps. Standard telephone-type keypad, $2.23 (1000). Delivery, 8 to 10 weeks ARO.

Oak Switch Systems Inc, 100 S Main St, Crystal Lake, IL 60014. Phone (815) 459-5000.

Circle No 541

LED MODULES

These edge-emitting LEDs operate at a nominal wavelength of 1300 nm and are available in FU-41SEL and FU-42SEL single-mode, and FU-31EL and FU-32EL multimode,



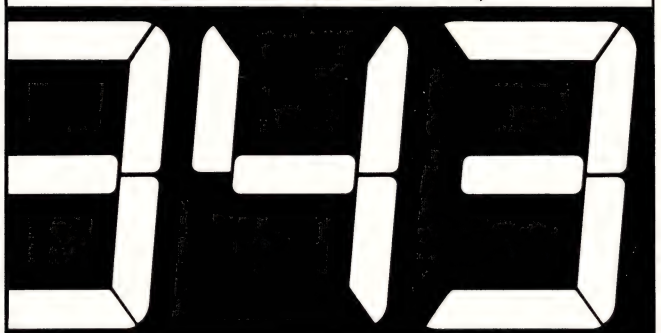
versions.

The FU-42SEL and the FU-32EL feature a thermoelectric cooler for temperature stabilization and couple 10 and 30 μW into single-mode and multimode fiber, respectively.

The FU-41SEL and FU-31EL modules don't have a thermoelectric cooler, and their respective outputs into single-mode and multimode fiber are 6 and 20 μW. $460 to $690 (10).

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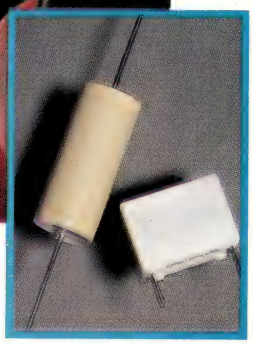
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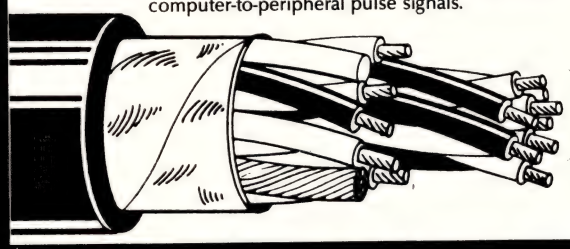
EMHART

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Close-up illustration of D-200 digital multi-pair flexible data transmission cable specifically designed for **parallel wide-word** computer-to-peripheral pulse signals.



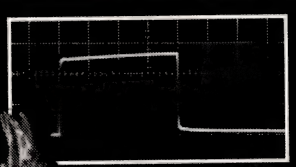


Photo A

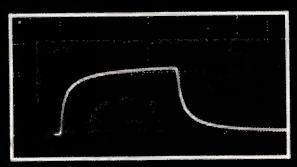


Photo B

A. INPUT PULSE*
Horizontal: 200. NS/Division
Vertical: 2. Volts/Division

B. OUTPUT PULSE*
Horizontal: 200. NS/Division
Vertical: 2. Volt/Division

*Type D-200 Cable
500 Ft. Length

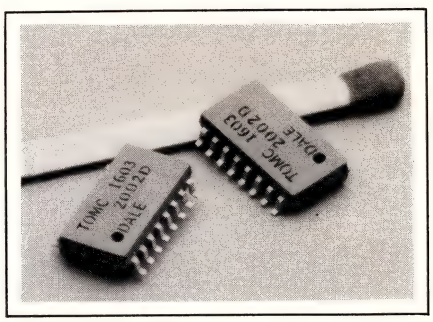
Call (213) 225-5611 today and ask for Frank Motley, M.T.S. or Sam Audish, M.T.S. for any applications assistance or detailed engineering data.

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Components

Inc, Semiconductor Div, 1050 E Arques Ave, Sunnyvale, CA 94086. Phone (408) 730-5900.

Circle No 542



RESISTORS

TOMC thin-film resistor networks come in small outline surface-mount packages. The networks feature values from 100Ω to 100 kΩ and are manufactured with tolerances of ±0.1, ±0.25, ±0.5, and ±1%. You can order them with resistance ratio matching to 0.1%; a temperature coefficient of ±25 ppm/°C is standard.

The networks are available in 14- and 16-pin models in one of two standard circuits. The 01 versions provide 13 or 15 nominally equal resistors, which are each connected to a common pin. The 03 models include 7 or 8 nominally equal isolated resistors. Both circuits are housed in molded epoxy cases. A network with ±1% tolerance and ±0.5% ratio match, $1.85 (2500).

Dale Electronics Inc, 2064 12th Ave, Columbus, NB 68601. Phone (402) 564-3131.

Circle No 543



KEYBOARDS

G80-2000 Series keyboards have an identical layout to the IBM 3270

CIRCLE NO 71

"I have it, but you'll have to take at least 250 lbs."

If your adhesive, coating and encapsulant supplier says your order quantities are too small, call us. At Emerson & Cuming, you can choose from the industry's broadest selection of custom and off-the-shelf materials in the quantities and package configurations that make sense for your production run.

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CIRCLE NO 73

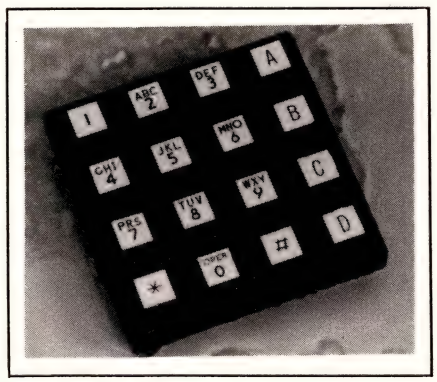
keyboard, with 24 function keys along the top and 10 keys on the left. Normally, only software written for the 3270 recognizes the extra 10 function keys. However, the vendor's keyboards come with an enhanced version of Smartkey so that users of IBM PC/XT, PC/AT, and compatibles can use the extra keys.

You can get the keyboards with N-key rollover, LED actuation-indicators, and programmable autorepeat as options. You can also order them in low-profile housing that conforms to DIN standards.

All the keyboards come with US/International, French, and German character layouts. You can also obtain custom versions of the keyboard that offer other layouts. $900 with all options.

Cherry Electrical Products, 3600 Sunset Ave, Waukegan, IL 60687. Phone (312) 360-3500.

Circle No 544



KEYPAD

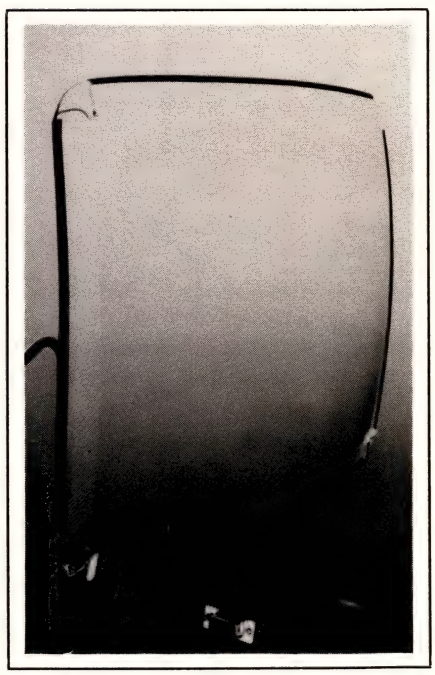
When mounted to a panel, Series 84 4×4 keypads are completely sealed to the environment. A mil-grade silicone rubber boot seals the contact system and also serves as the mounting seal.

The snap-dome contact system provides tactile feedback for the operator. The contact side of the dome is gold plated to ensure low contact resistance for 3×10^6 operations/position. Each keypad provides EMI shielding.

The keypad buttons are located on 0.75-in. centers; you can remove them and interchange them. The standard button color is white, and the legends are printed in a black epoxy ink that bonds with the button's plastic surface. Special legends and button colors are available. $25.85 (100). Delivery, six to eight weeks ARO.

Grayhill Inc, Box 10373, La Grange, IL 60525. Phone (312) 354-1040. TWX 910-683-1850.

Circle No 545



TOUCHSCREEN

The pressure-sensitive IntelliTouch Trace screen uses two small transducers to send very short bursts of acoustic waves along the horizontal and vertical edges of the screen. As each burst travels along the edge of the glass, a reflective array diverts a small fraction of the incident energy across the glass screen.

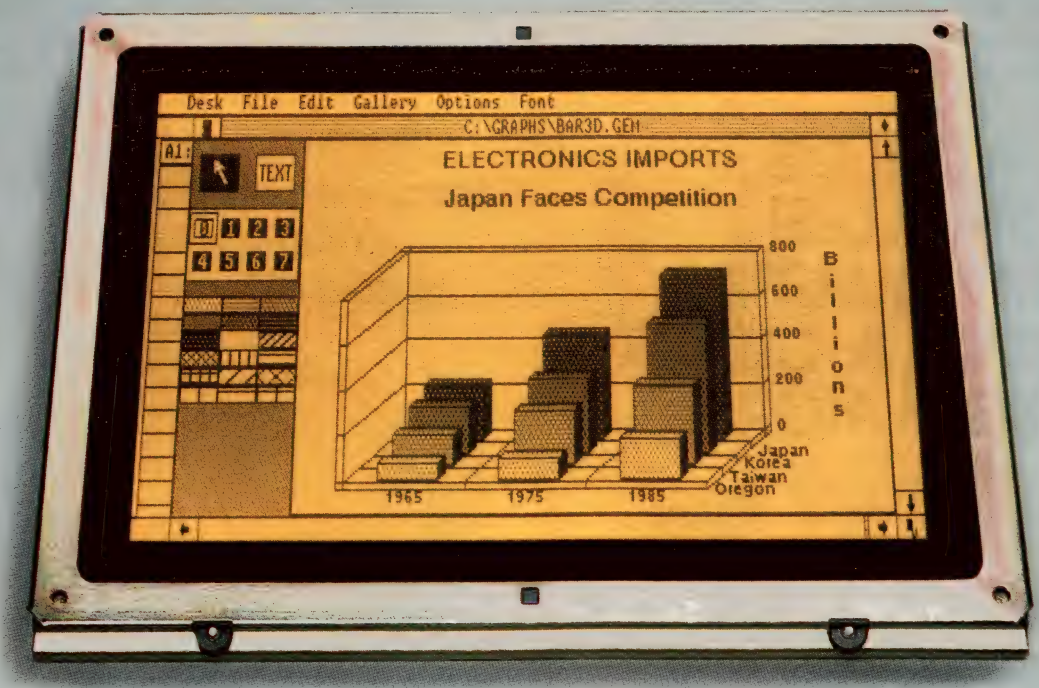
A mirror-image array receives these wavelets and sends them to two receiving transducers. The transducers generate electrical signals and send them to the controller. Depending on the controller used, the screen resolution can range as high as 100 points/in.

The screen comes with either RS-232C or bus controllers as well as menu-driven, general-purpose application software. You can order a

Display technology is often the last thing you specify.



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LCD display and Planar EL display photographed under identical ambient lighting conditions.

From a customer's viewpoint, there's only one real window into your product.

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For flat panel displays, there's a simple, yet elegant solution. Planar's electroluminescent (EL) display. Why is EL the preferred display technology? Better viewing angle. Better brightness. Better contrast.

It adds up to superior performance.

So contact us today. Choose the flat panel display that surpasses all others from everyone's point of view.

For a brochure, please phone either 503-690-1100 or 503-690-1102, or write to

PLANAR SYSTEMS, INC.
1400 N.W. Compton Drive
Beaverton, Oregon 97006.

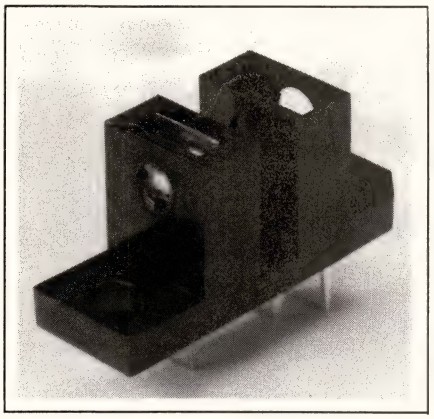
PLANAR

CIRCLE NO 79

switches and linear-control devices. The vendor has tested the screens over 1 million actuations and can supply screens that meet various military specifications for ground or airborne applications. $55 to $500. Delivery, 10 to 12 weeks ARO.

CAM Graphics Co Inc, 15 Ranick Dr West, Amityville, NY 11701. Phone (516) 842-3400.

Circle No 549



INTERRUPTOR MODULE

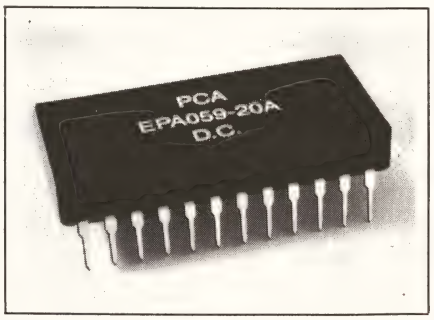
The SFH 910 differential photo interruptor module contains TTL-compatible circuitry that provides a counting pulse and a directional pulse that let you detect the direction of motion. The unit consists of a GaAlAs IR emitter and a hybrid photodetector.

The photodetector encompasses a split photodiode with amplifiers, Schmitt triggers, and evaluation logic; the module also features a built-in daylight-supression filter. Both the counting pulse and directional-recognition signals are npn open-collector outputs compatible with TTL circuitry.

You can use the module to encode mechanical-shaft rotation speed and direction. It accepts code wheels with slot widths as small as 0.85 mm. You can obtain a 96-slot code wheel as an option. SFH 910, $5.60 (1000); disc, $0.73.

Siemens Components Inc, Optoelectronics Div, 19000 Homestead Rd, Cupertino, CA 95014. Phone (408) 725-3520.

Circle No 550



DELAY LINES

Housed in 24-pin DIPs, the EPA059, EPA060, and EPA061 Series 20-tap delay lines provide 20- to 1000-nsec delays. Each version has four 50Ω lines with 2- to 200-nsec delays, six 100Ω units with 20- to 1000-nsec delays, and five 200Ω devices with 20- to 1000-nsec delays.

Nominal tap-to-tap delays for all

WORLD'S SMALLEST SMT QUARTZ CRYSTALS & CLOCK OSCILLATORS



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● 10KHz—35MHz ● Hi-temp mounting—260°C for 20 seconds ● Shock-resistant, leadless, ceramic chip carriers ● Low power use ● Hi-stability ● Low aging ● Standard frequencies —off the shelf

Plus, the world's smallest quartz crystals in ceramic and metal carriers with a full range of lead configurations for thru-hole mounting.

MICRO CRYSTAL DIVISION / SMH
35 EAST 21st STREET, NEW YORK, NEW YORK 10010

CIRCLE NO 80

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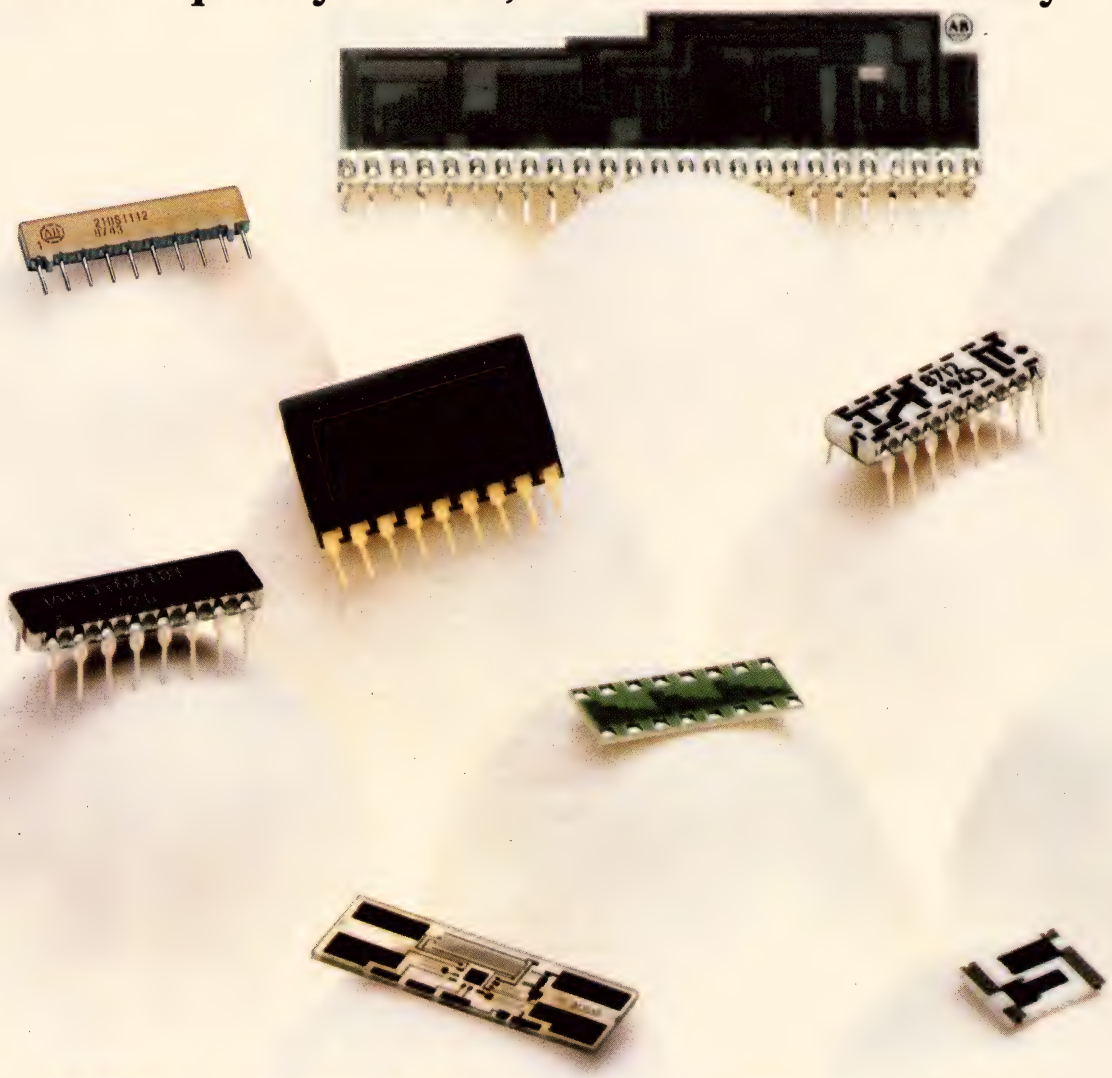
Soundcoat's exclusive SOUNDMAT PBM is made with a sheet of thin flexible limp mass sandwiched between two layers of foam to provide absorption, transmission loss and isolation. It has excellent resistance to oxidation, UV light and weathering. And our flexible plastic barrier meets UL-94V-0. For outdoor applications, aircraft, vehicles, business machines and EDP, generators, compressors and health care equipment.

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Send for your free noise control bulletin no. 719, today.

CIRCLE NO 81

When quality counts, count on Allen-Bradley



We provide solutions for dozens and dozens of applications

If you have a resistor network problem, bring it in early to the problem solvers at Allen-Bradley. We have a broad range of solid ceramic thick film I-SIPs and I-DIPs, surface mount SARAs, precision thin film SIPs, DIPs, and Chips, and hybrid network substrates. When standard networks do not meet your needs, we have 20 years experience in designing custom networks to meet your application . . . and the materials and CAD tools to do it.

Allen-Bradley's proprietary resistive, conductive and termination materials are unique in the industry in that we manufacture and control our own thick film ink system.

Our highly automated printing process and the effective use of SPC result in the volume manufacture of stable resistor networks of high quality and reliability.

Our thin film resistor networks consist of integrated films of chromium cobalt deposited on specially selected ceramic or glass substrates resulting in networks having precision tolerance and long term stability.

We would like to be of service to you.
Please call 800-592-4888, or 800-292-4888 in Texas, or write to Allen-Bradley, 1414 Allen Bradley Dr., El Paso, TX 79936-6415.

A-B QUALITY

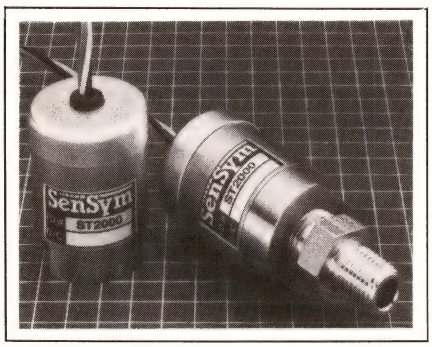
ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

three series are 1, 2.5, and 10 nsec for 50Ω lines; 1, 2.5, 5, 10, 25, and 50 nsec for 100Ω lines; and 1, 2.5, 5, 25, and 50 nsec for 200Ω lines. The maximum output rise-times range from 3 to 20 nsec for 50Ω units and 3 to 100 nsec for the 100 and 200Ω lines.

All lines have their outputs on pin 23. Inputs are on pin 1 for the EPA060 units and on pin 2 for EPA059 and EPA061 Series devices. $5.82 (1000) for the EPA059-100B, a 100Ω, 100-nsec total delay unit with a 5-nsec/tap delay.

PCA Electronics Inc, 16799 Schoenborn St, Sepulveda, CA 92121. Phone (818) 892-0761.

Circle No 551



PRESSURE SENSORS

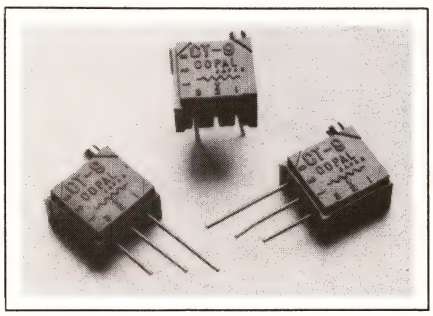
ST2000G Series pressure transducers are suitable for measurement of hostile media in harsh environments. Encased in rugged stainless-steel packages, the transducers each feature an IC sensor element and signal-conditioning circuitry. They have full-scale pressure sensing capability that ranges from 15 to 300 psig.

You can obtain the transducers with either 1 to 6V dc or 2.5 to 12.5V dc output for each pressure range. Their sensor output options include FS spans of 5V±200mV, and 0-pressure offsets, trimmed to within ±100 mV, that allow you to interchange transducers without recalibrating.

All the transducers feature temperature compensation to within ±0.02%/°C. The sensors are optimized for 0 to 70°C operation but will operate from −40 to +85°C. The transducers' operating voltage ranges from 12 to 30V dc. $125.

Sensym Inc, 1255 Reamwood Ave, Sunnyvale, CA 94089. Phone (408) 744-1500.

Circle No 553



TRIMMERS

The adjustable screw design of each CT-9 Series 18-turn trimmer resistor permits actuation of a worm gear that turns a wiper assembly around the trimmer's circular resistive element. The trimmers' resistance values range from 10Ω to 5 MΩ.

The multicontact precious-metal wipers in these trimmers have low 1% contact-resistance variations. The trimmers are rated for 500-mW at 70°C and are derated to 0W at 125°C. Other pertinent specs include a 300V dc maxvoltage rating, a 200-cycle rotational life, and a 360g-cm shaft torque rating.

Sealed with O-rings, the trimmers pass leak tests at 85°C and can withstand soldering temperatures of 350°C for as long as 3 sec. The trimmer operating range spans −55 to +125°C. $0.79 (5000).

Mepcopal, 11468 Sorrento Valley Rd, San Diego, CA 92121. Phone (619) 453-0332.

Circle No 552

SUPPRESSORS

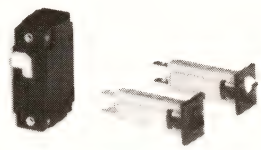
420E2 Series transient voltage suppressors are suited for field installation on equipment that has inadequate levels of transient protection. Each model has two pairs of circuits with line-to-line and line-to-ground protection.

Text continued on pg 134

(ADVERTISEMENT)

More quality switching components from P&B

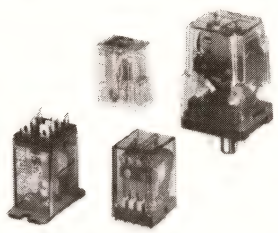
Circuit Breakers



P&B circuit breakers provide the quality you need at a price you can afford. Both thermal and magnetic types are available, and many are UL recognized as supplementary protectors and CSA certified as appliance component protectors.

CIRCLE NO 83

General Purpose Relays



One of the broadest lines of general purpose relays in the industry is offered by P&B. Open and enclosed styles are available with various contact materials, contact arrangements, termination styles and coil voltages.

CIRCLE NO 84

Time Delay Relays



P&B time delay relays combine precision, solid state timing circuits with our proven electromechanical relays. A wide selection of timing functions, timing ranges, degrees of precision and package styles permits you to select a unit with just the features you need.

CIRCLE NO 85

Make your move to P&B for high quality, board mount relays.



Cost Effective 1mA—30A Switching

For applications ranging from consumer goods to industrial controls, P&B relays have the features you need for 1 milliamp through 30 amp switching on your printed circuit board. These cost effective relays meet requirements established by international regulatory agencies. Many models are available from stock, and they're all built to the same exacting specifications that have made P&B relays the standard of the industry.

10A, SPDT Switching

T70 relays are low-cost, SPDT units offering silver or silver-cadmium oxide contacts for loads from 1 milliamp through 10 amps. Available with an immersion cleanable, sealed case.

4,000V Isolation

RK series relays feature 8 mm coil-to-contact spacing for 4,000 volt isolation. SPDT models switch loads to 20 amps, and DPDT models switch up to 5 amps. Both sealed and unsealed versions are offered.

30A Workhorse

T90 relays have SPDT contacts of silver-cadmium oxide for 30 amp loads or silver for loads up to 15 amps. Available as an open relay or sealed for immersion cleaning. A snap-on dust cover is offered for open models.

Quick Connects, Too

T91 relays feature the same ratings as T90 relays and provide both quick connects and printed circuit terminals for load connections. Sealed and dust cover versions are available. Optional case provides flanges for panel mounting and quick connects for all connections.

Find Out More

Contact us today for details on P&B printed circuit board relays. Call toll-free 1-800-255-2550 for the name of your nearest P&B distributor or sales representative. Potter & Brumfield, A Siemens Company, 200 South Richland Creek Drive, Princeton, Indiana 47671-0001.

Regional Sales:
Braintree, MA, (617) 848-6550; Mission Viejo, CA, (714) 582-1231; Princeton, IN, (812) 386-2130; Bristol, England, (0454) 616263.



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Potter & Brumfield Inc., 200 S. Richland Creek Dr., Princeton, IN 47671-0001

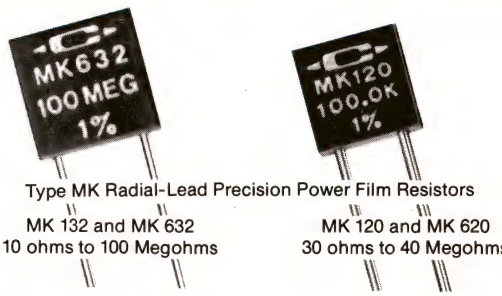
☐ Please send more information about P&B printed circuit board relays.

Name Firm Address City Phone Title State Zip

EDN072188

CIRCLE NO 86

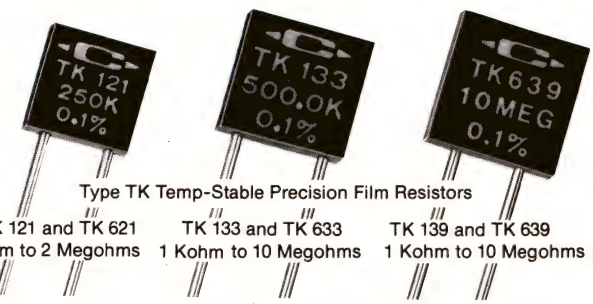
Radial-Lead Precision Film Resistors from Caddock combine high values and tight tolerances with a choice of two high-power densities or three low TCs.



Type MK Radial-Lead Precision Power Film Resistors

MK 132 and MK 632
10 ohms to 100 Megohms

MK 120 and MK 620
30 ohms to 40 Megohms



Type TK Temp-Stable Precision Film Resistors

TK 121 and TK 621
1 Kohm to 2 Megohms

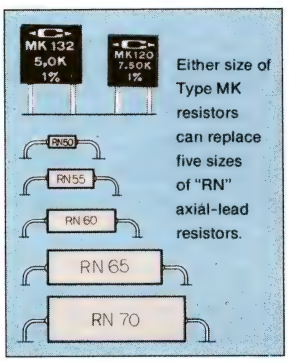
TK 133 and TK 633
1 Kohm to 10 Megohms

TK 139 and TK 639
1 Kohm to 10 Megohms

Type MK Radial-Lead Precision Power Film Resistors utilize Caddock's Micronox® resistance films to achieve high power density and an extended range of resistance values:

Available in two rectangular radial-lead packages that include values as high as 100 Megohms, these high-density film resistors permit electronic circuit designers to optimize packaging and PC board layouts with resistors that meet all these specifications:

	MK 120	MK 620	MK 132	MK 632
• **Resistance Range**	30 ohms to 2 Megohms	2.1 Megohms to 40 Megohms	10 ohms to 5 Megohms	5.1 Megohms to 100 Megohms
• **Resistance Tolerance**	±1.0% is standard, to ±0.1% on special order, depending on value and model.			
• **Wattage**	0.5 Watt	—	0.75 Watt	—
• **Voltage**	200 V	200 V	400 V	400 V
• **Temperature Coefficient**	50 PPM/°C	80 PPM/°C	50 PPM/°C	80 PPM/°C
	Temp Range: −15°C to +105°C, ref. +25°C.			
• **Package Size**	.250" square, .100" thick		.300" square, .100" thick	



Either size of Type MK resistors can replace five sizes of "RN" axial-lead resistors.

These full-size photos comparing the Type MK resistors to "RN" style axial-lead resistors show that the largest Type MK, which is rated at 3/4 watt, requires less board space than the 1/20 watt "RN 50".

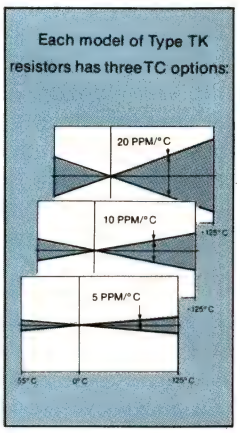
And within their voltage ratings, both sizes of Type MK resistors can replace five sizes of "RN" resistors, including the 1/2 watt "RN 70" which requires 10 times the board space of the MK 132 !

This combination of higher power rating and smaller size can also lower procurement costs by replacing many sizes of axial-lead resistors with Type MK resistors that have a 'standard' size and mounting dimensions.

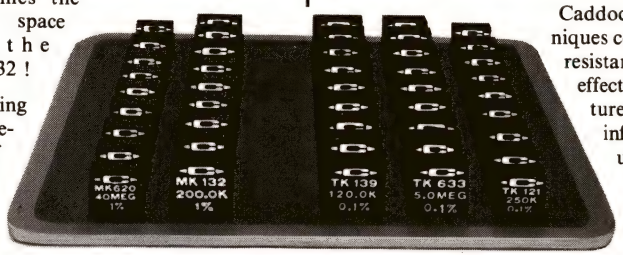
Type TK Temp-Stable Precision Film Resistors with Caddock's Tetrinox® resistance films combine a choice of TCs of 5, 10 or 20 PPM/°C, a wide resistance range and tight tolerances.

Type TK Temp-Stable Precision Film Resistors provide a combination of performance advantages that are unique in a miniature resistive component:

- **Three Standard Temperature Coefficients:** 5 PPM/°C, 10 PPM/°C or 20 PPM/°C over the temperature range from −55°C to +125°C. (+105°C max. for values above 500 Kohms or 1.5 Megohms, depending upon model.)
- **Resistance Range:** 1 Kohm to 10 Megohms.
- **Precision Tolerances:** ±1.0% is standard, and tolerances as close as ±0.05% are available on special order.
- **Load Life Stability:** 0.05% maximum ΔR after 2000 hours at full power at +125°C. (0.2% max. for values above 500 Kohms or 1.5 Megohms, depending upon model.)
- **Two Power Ratings:** .2 watt and .3 watt.



The Model TK 121, TK 133 and TK 139 precision film resistors have demonstrated performance which meets the requirements of Mil-R-55182/9 for thermal shock, moisture resistance, shock and vibration, dielectric withstanding voltage and low temperature operation.



Caddock's high-thru-put manufacturing techniques combined with our advanced Tetrinox® resistance film technology provide this cost-effective way to match the needs of temperature stable circuitry. For price and delivery information on both production and evaluation quantities, contact Caddock's main offices in Riverside, California.

Discover how easily these problem-solving resistors can improve the performance and reliability of your equipment, too. For your copy of the latest edition of the Caddock 28 page General Catalog, and specific technical data on any of the more than 200 models of the 19 standard types of Caddock High Performance Film Resistors and Precision Resistor Networks, just call or write to –

Caddock Electronics, Inc., 1717 Chicago Avenue, Riverside, California 92507 • Phone (714) 788-1700 • TWX: 910-332-6108

CADDOCK

HIGH PERFORMANCE FILM RESISTORS

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NON-POLARIZED

Surface Mount

2000 HOUR LIFE TEST RELIABILITY

POLARIZED

CAUTION LOW CEILING MAX. HEIGHT 5.5 mm

Lead-time, Cost, Production Savings

EXPANDED −55°C +105°C TEMPERATURE

ANTI-SOLVENT

All signs point to Nichicon surface mount electrolytics.

In surface mount capacitors, success breeds success.

And with four new surface mount electrolytic capacitor series ready to help your products meet their marketing window—on budget, all signs now point to Nichicon.

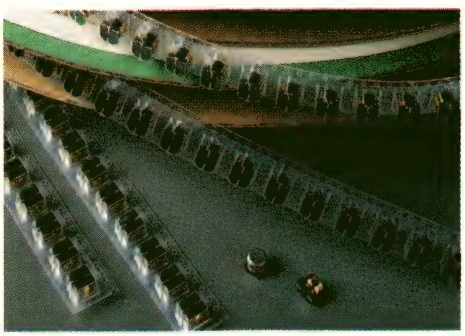
Save time. Save space. Save money.

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More Nichicon advantages.

Your real bottom line though is still capacitor performance. And with four tantalum equivalent Nichicon surface mount electrolytic capacitor series to choose from, your chances of finding your capacitor choice are better than ever.



SERIES	FEATURE
UP	Non-polarized/ − 40°C ~ + 85°C 6.3 ~ 50V/0.1 ~ 47μF
WX	2,000 hour life/5.5mm max. ht. 4 ~ 50V/0.1 ~ 220μF
UT	− 55°C ~ + 105°C 4 ~ 50V/0.1 ~ 100μF
MX	2,000 hour life/6.3mm max. ht. 4 ~ 50V/0.1 ~ 220μF

Of course, each series is carrier-taped and reeled and features Nichicon's anti-solvent design.

For your free Nichicon Surface Mount Electrolytic Capacitor data sheet or more information, call one of our customer service representatives at (312) 843-7500. Or, call your local Nichicon representative or distributor.

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The capacitor choice.

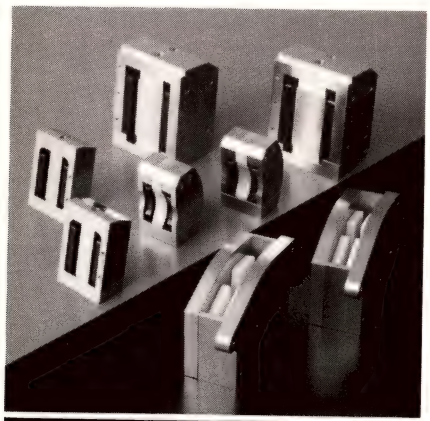
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One good idea after another.

CIRCLE NO 88

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"SHIN-ETSU CHEMICAL'S" RARE EARTH MAGENT: HIGH-PERFORMANCE, COMPACT, LIGHTWEIGHT



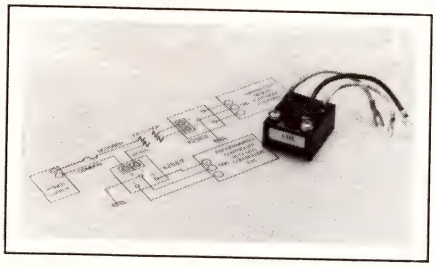
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SHIN-ETSU's magnetic materials and assembly parts for voice coil motors have achieved proven results and the high evaluation of the world's computer manufacturers. Used for head positioning in the disk drive units of computers, their high-quality magnetic characteristics make them incomparable when it comes to compactness and lightness.
The SHIN-ETSU RARE EARTH MAGNETS are all of the 2-17 system and when compared to permanent magnets, have superior characteristisc as regards permanence, strength of field, maximum energy product, temperature coefficient and otehr properties.
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Shin-Etsu Chemical Co.,Ltd.
LOS ANGELES
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CA 90501 USA Phone.(213)533-8559

134 CIRCLE NO 89

Components



The family includes devices with operating line voltages of ±12, ±25, ±28, ±36, ±50, and ±60V max; the maximum clamping voltages at 2000A spec at 22, 44, 46, 60, 80, and 95V, respectively. You can make electrical connections using two screws for line connections and three fork terminals for equipment connections.

The suppressors feature a short-circuit failure mode. Their maximum standby current equals 5 μA and their line throughout resistance specs at 12Ω. All the suppressors operate from −55 to +100°C. From $24 (100).

General Semiconductor Industries Inc, 2001 West Tenth Pl, Tempe, AZ 85281. Phone (602) 968-3101. TWX 910-950-1942.

Circle No 554

DC/DC CONVERTER

By employing surface-mount technology on a ceramic substrate, the type 3T switch-mode dc/dc converter produces an output power of 50W from a pc-board mount single in-line package that measures 2.0×1.1×0.16 in. It can provide full output power over a 0 to 70°C temperature range without additional heatsinking. You can program the converter with shorting links so that it produces an output voltage of 5, 12, 15, 18, or 24V. At 12V, it achieves an operating efficiency of around 94%.

The converter accepts a dc input voltage of between 11 and 40V; you can also configure the device so that it operates as an ac/dc converter. Zero to full-load output regulation is 0.5% for an output voltage of 5V and 1.0% for all other output voltages. The line regulation over the 11 to 40V input range is 1% for a 5V output and 2% for other output voltages. For ±10% input changes, however, the line regulation for all output voltages is only 0.2%. The maximum output current is 3A, but you can add external power transistors to provide greater output currents. £10 (100).

Bicc-Citec Ltd, Westmead, Swindon, Wiltshire SN5 7YT, UK. Phone (0793) 487301. TLX 449112.

Circle No 565

SWITCHMODE SUPPLIES

RL150 Series power supplies deliver 150W of output power from a package that measures 8.4×2.4×4.6 in. All versions of the supply have a 5V main output that can deliver a maximum continuous current of 15A. The secondary outputs are either ±12V and 12V, ±12V and 24V, ±12V and −5V, or ±15V and −5V. You can trim the output voltages by ±5%. The supplies will operate with a main output load of as little as 1.2A with all other outputs unloaded, and they can cope with the high peak current requirements of, for example, disk drives. Other features include 75-kHz FET switching, warm- and cold-start inrush current control, and line input failure signalling.

The load regulation for a 40% change on a 60% load is ±0.5% for the main output, ±2% for the split positive and negative supplies, and ±0.5% for the single supply secondary. The supplies operate from ac line input voltages of 99 to 132V or 187 to 265V and have a line regulation of ±0.1% for a ±15% line input change. They meet the relevant IEC, CSA, VDE, UL, and BS reliability standards as well as the requirement of NATO standard AQAP4.

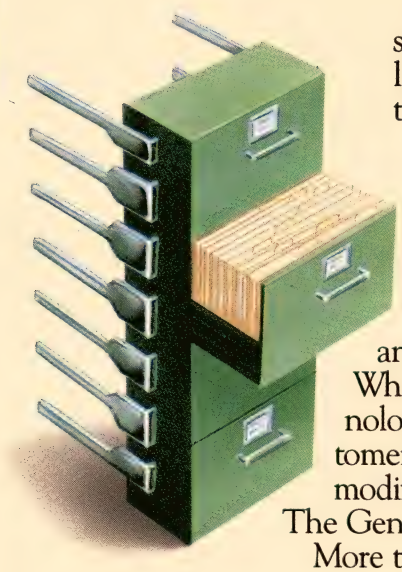
Coutant Electronics Ltd, Kingsley Ave, Ilfracombe, EX34 8ES, UK. Phone (0271) 65656. TLX 46310.

Circle No 568

Qualidyne Systems Inc, 3055 Del

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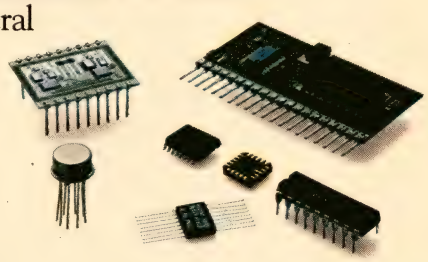
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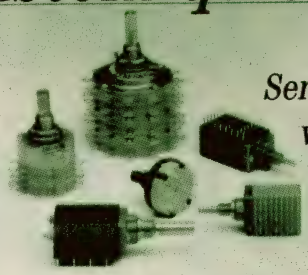
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CANTHERM

CIRCLE NO 92

Components

Sol Blvd, San Diego, CA 92154. Phone (619) 575-1100. TLX 709029.
Circle No 569

HV SUPPLY

To meet the requirements of the latest ion implantation equipment, Series 1200 high-voltage power supplies are capable of delivering 485 kV max at currents as high as 2 mA.

The power supply features independent voltage and current control with automatic cross-over between the two modes. The overcurrent protection is built into the supply; in the event of output arcing, the damage to components is minimized by the low level of stored energy in the supply's multiplier stack. The supply features a 0- to full-load output regulation of 0.01%; its output ripple equals 0.1% of the rated output voltage p-p to 200 kV. Above 200 kV, its output ripple is less than 0.5%.

The power supply offers a rack-mounted converter that operates from 108 to 132V or 216 to 264V, 48 to 62 Hz ac line supplies. It also provides a voltage multiplier stack whose sections are rigidly joined so that you can mount the stack in any orientation. Around £19,000 for a 485 kV model. Delivery, 20 weeks ARO.

Bonar Wallis Hivolt Ltd, Dominion Way, Worthing, Sussex BN14 8NW, UK. Phone (0903) 211241. TLX 877112.

Circle No 572

MOSFET MODULES

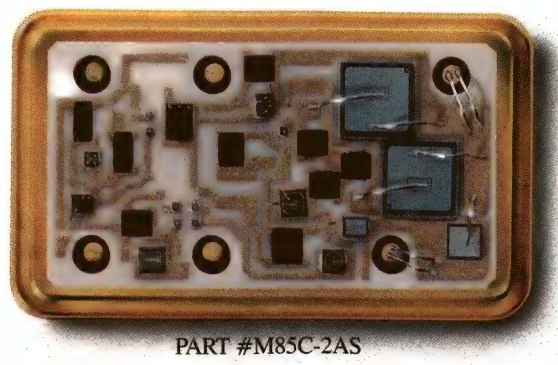
CPY213E MOSFET modules provide nearly lossless feedback circuit designs. They include two n-channel HexSense die and two fast-recovery diodes paralleling two p-channel HexFET die in an H-bridge configuration.

The on-resistance measures 0.18Ω for the bottom-side n-channel devices and 0.3Ω for the top-side p-channel devices, providing designers 6.1A/leg at 45°C. The sensing

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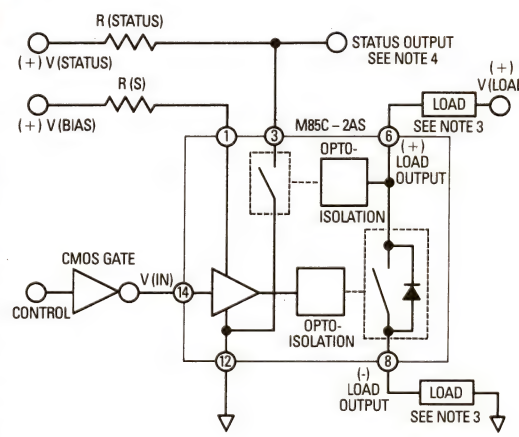


PART #M85C-2AS

ELECTRICAL CHARACTERISTICS (–55°C to +105°C unless otherwise noted)

	Min	Max	Units	
Bias Voltage (V_{BIAS})	3.8	32	V_{DC}	See Note 1
Bias Current (I_{BIAS})		15	mA	$V_{BIAS} = 5 V_{DC}$
Control Voltage (V_{IN})	0	18	V_{DC}	
Control Current (I_{IN})		250	µA	$V_{IN} = 5 V_{DC}$
Turn-Off Voltage	3.2		V_{DC}	–55°C to +25°C
$V_{IN\,(OFF)}$	2.8		V_{DC}	+25°C to +105°C
Turn-On Voltage		0.5	V_{DC}	–55°C to +25°C
$V_{IN\,(ON)}$		0.3	V_{DC}	+25°C to +105°C
Continuous Load Current		2.0	A	–55°C to +25°C
I_{LOAD}		400	mA	+105°C
Output Trip Current (I_{TRIP})	8 (TYP.)		A	+25°C, 100 ms
Continuous Load Voltage (V_{LOAD})		60	V_{DC}	
Output Leakage Current (I_{LEAK})		2	mA	
On-Resistance (R_{ON})		0.28	Ohms	
Turn-On Time (T_{ON})		3.0	ms	
Turn-Off Time (T_{OFF})		1.0	ms	
Status Voltage (V_{STATUS})	1	18	V_{DC}	
Status Current (I_{STATUS})		0.6	mA	See Note 2

Notes:
1. Series resistor is required for bias voltages above $6V_{DC}$. $RS = (V_{BIAS} - 5\,V_{DC})/15$ mA
2. A pull up resistor is required for the status output. $R_{STATUS} = V_{STATUS}/600$ µA
3. Output will drive loads connected to either terminal (sink or source).
4. Status output is low when the load output is off.



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Teledyne Solid State, 12525 Daphne Avenue, Hawthorne, California 90250.

CIRCLE NO 93

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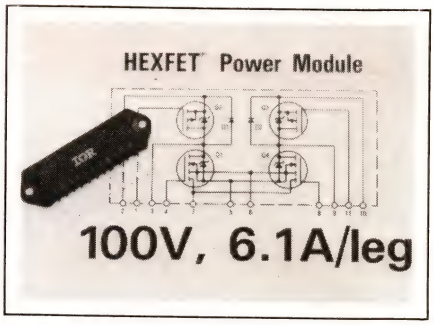
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CIRCLE NO 94

Components

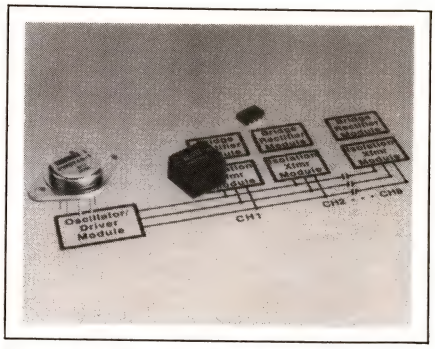


circuits on the HexSense dice are formed by isolating a number of cells on the HexFET die from the main-source metallization. Because each cell in the HexFET matrix is parallel and identical, sampling current in one or several cells gives a scaled indication of the main current.

The units are housed in 0.5-in., 11-pin single in-line packages. $8.65 (1000). Delivery, four to eight weeks ARO.

International Rectifier, 233 Kansas St, El Segundo, CA 90245. Phone (213) 607-8939.

Circle No 558



CONVERTER SYSTEM

The PWS740 system provides multiple channels of 7 to 20V dc bipolar outputs with isolation 100% tested and guaranteed to 1500V ac. By sharing a common power driver among several channels and using board-mounted transformers and rectifiers, you can generate bipolar isolated output as high as ±30 mA.

The system consists of three integrated components. The PWS740-1 is a 400-kHz oscillator/driver in a TO-3 package; it handles as many as eight signal channels. The PWS740-2 is a trifilar-wound isolation trans-



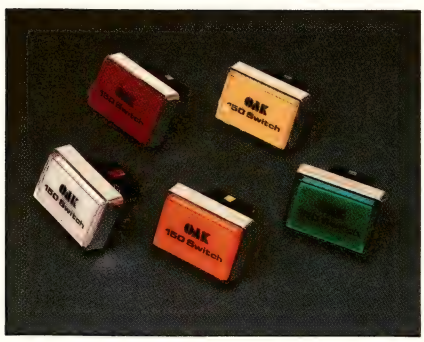
Low-Profile, Full Travel Membrane Based Keyboards

Oak's Low-Profile FTM uses an optomized keymodule that provides improved consistency, better feel and lower cost per keystroke position. DIN compatible, Oak FTM keyboards are designed for high speed data entry systems that require long life and operator comfort.

The patented switch design has a profile of just 19.9 mm (0.785 inches). Operating (finger) forces of the keystroke are available from .9 to 6 ounces. The keyswitch features only four parts providing extremely high reliability – in excess of 50 million cycles.

Contact: Oak Switch Systems Inc.
P.O. Box 517
Crystal Lake, IL 60014
Phone: 815/459-5000

CIRCLE NO 95



Bright, Easy-To-Read, Versatile Momentary Pushbutton Switch

This Series 150 lighted pushbutton from Oak is an economical way to go from dry circuits to 10.5 amps in an attractive, ruggedly constructed switch – ideal for appliances, vending machines and electronic games.

Offered in Form Z or Form C, double make, double break construction. Standard colors of the 1″ × 1-1/2″ buttons are white, red, blue, yellow, amber and green. Printed subsurface legend plates may be hot stamped, pad printed or engraved. The standard T-1 3/4 wedge-based lamp is replaceable from the rear of the switch.

Contact: Oak Switch Systems Inc.
P.O. Box 517
Crystal Lake, IL 60014
Phone: 815/459-5000

CIRCLE NO 247



Flexible, Durable, Attractive Micromotion Membrane Switches

Oak Switch provides precise graphics to your specifications with textures, LED's and tactile feel as you require. Available in A-type with rigid single- or double-printed circuit boards (1 to 50 VAC or DC; 0.05 to 100 mA). Type C products are completely film-based, using a non-rigid polymer-substrate. Termination is via a "tail" compatible with standard commercial connectors. Available in 1 to 30 VAC or DC; 0.05 to 50 mA.

Contact: Oak Switch Systems Inc.
P.O. Box 517
Crystal Lake, IL 60014
Phone: 815/459-5000

CIRCLE NO 248



CIRCLE NO 249

former with a ferrite core and is encapsulated in a compact plastic package. The PWS740-3 is a high-speed rectifier bridge housed in a plastic 8-pin DIP.

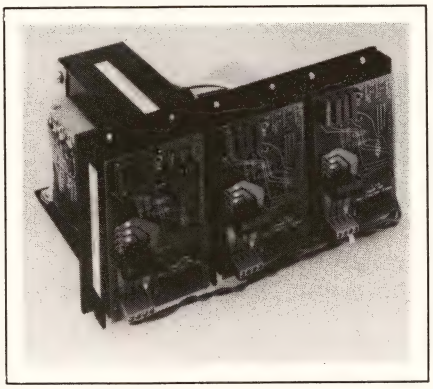
When using two or more PWS740-1 modules, a sync pin synchronizes operation and eliminates troublesome beat-frequency switching noise. A TTL-compatible enable pin allows you to shut down the output. PWS740-1, $12.75; PWS740-2, $2.50; PWS740-3, $1.25 (100).

Burr-Brown Corp, Box 11400, Tucson, AZ 85734. Phone (602) 746-1111.

Circle No 559

MOTOR DRIVES

Each Series 600 subsystem consists of as many as three complete servomotor drive channels combined with a power supply. The subsystems accommodate a wide range of PWM



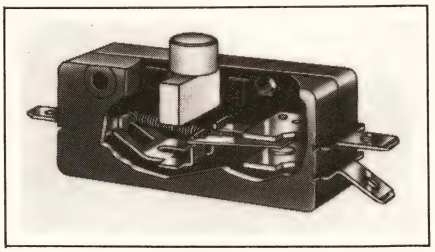
(pulse-width-modulated) amplifier types.

Amplifiers compatible with the 600 chassis provide current ratings between ±2 and ±10A at output voltages of ±20 to ±150V. All the servoamplifiers are protected against short circuit, overcurrent, undervoltage, overvoltage, and excessive temperatures.

You can order the chassis with different amplifiers for each axis. The amplifier modules provide 4-quadrant operation and a 1-kHz bandwidth. From $450 for a single axis version equipped with an amplifier that delivers 100W continuously. Delivery, six weeks ARO.

Copley Controls Corp, 375 Elliot St, Newton, MA 02164. Phone (617) 965-2410.

Circle No 560



SWITCHES

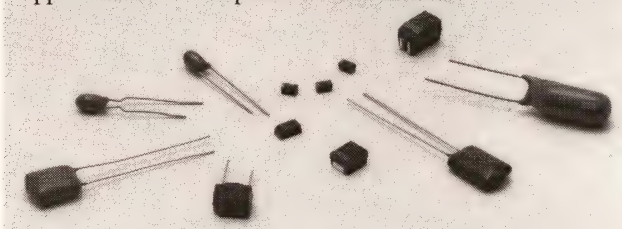
DL Series general-purpose switches are available with either silver contacts rated for 15 or 25A or gold crosspoint contacts rated at 0.1A. All ratings are at 125 or 250V ac. The thermoplastic case features a hinged design, which eases installa-

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CIRCLE NO 96

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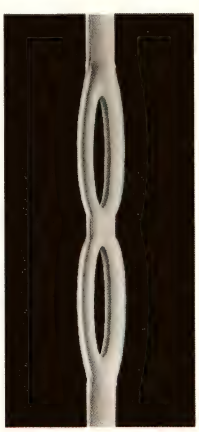
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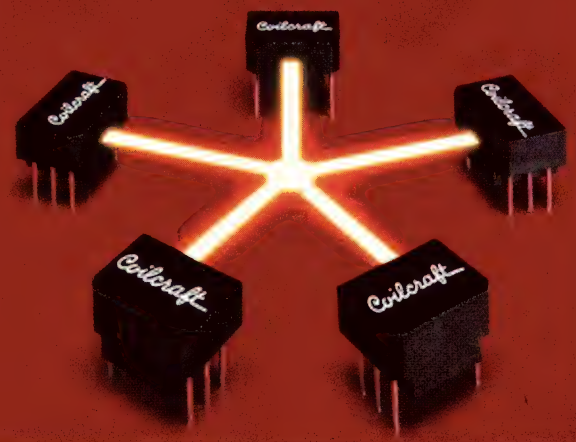
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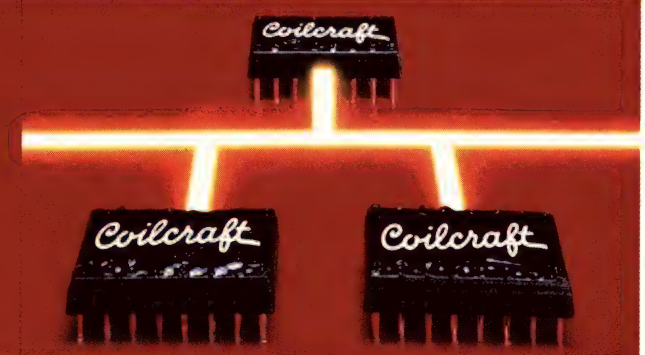
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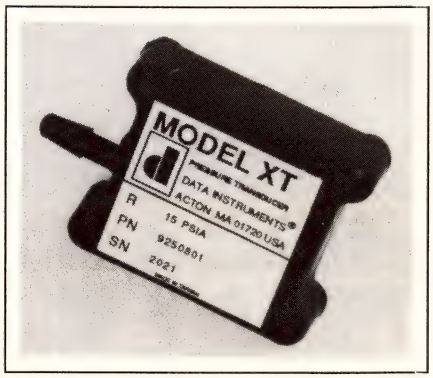
Components

tion of different style levers and actuators—both are available in a choice of two pivot positions.

You can get the devices with a wear-resistant thermoplastic button actuator. The company can design special button lengths, forms, and colors to meet any requirement. The switches are offered in either spst or spdt configurations (NO or NC). A unit that includes actuator and silver contacts rated for 15A, $0.95 (1000).

Cherry Electrical Products, 3600 Sunset Ave, Waukegan, IL 60087. Phone (312) 360-3518.

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TRANSDUCERS

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CIRCLE NO 102

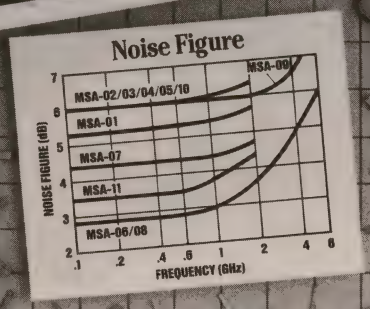
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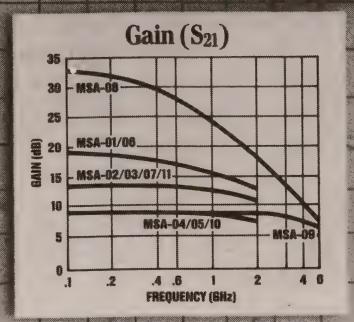


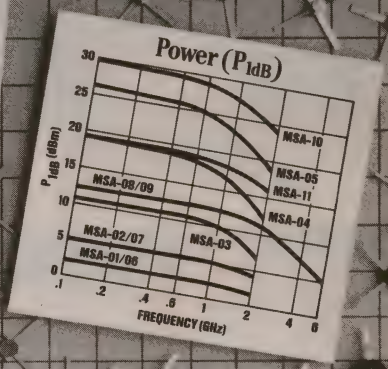












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- micro-X Stripline
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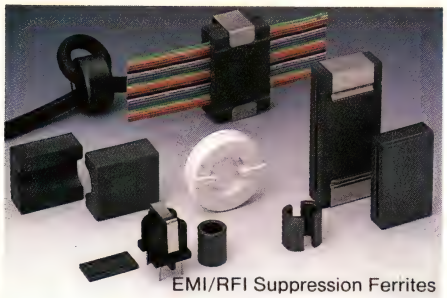
CIRCLE NO 103

How to Beat EMI/RFI Once and For All!

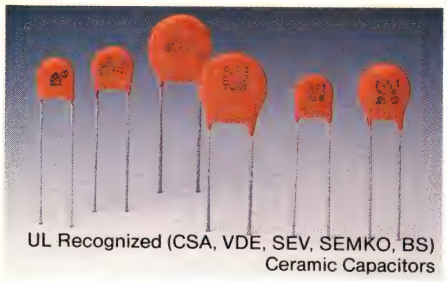
With high performance TDK EMI/RFI components



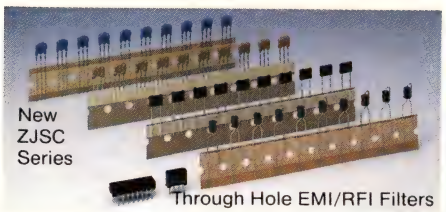
EMI/RFI Suppression Filters



EMI/RFI Suppression Ferrites

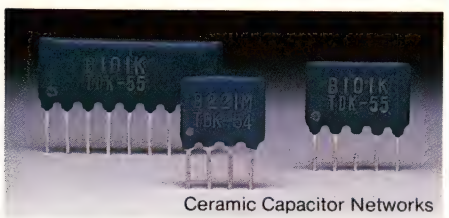


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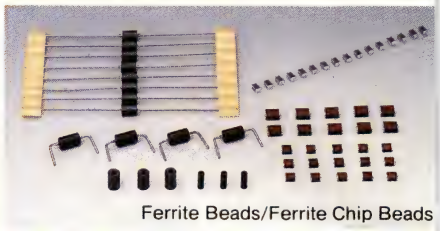
With recent advances in digitization and integration, electronic circuits require a higher degree of reliability than ever before. Advanced circuits and devices now have to overcome expanding EMI environments and the tighter international EMI/RFI standards enforced by the FCC, CISPR, and DIN. TDK technology can help.

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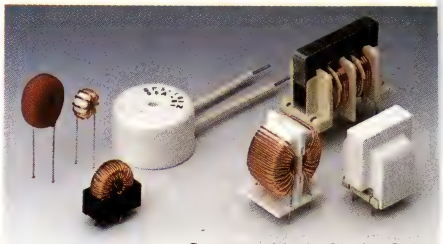
Our products include ferrite cores, amorphous magnetic materials, ceramic capacitors, varistors, radio wave absorbent materials, and electromagnetic shielding materials. All carry the TDK guarantee of reliability, and are suitable for a variety of applications, including advanced computers, automobile electronics, and OA and FA equipment.

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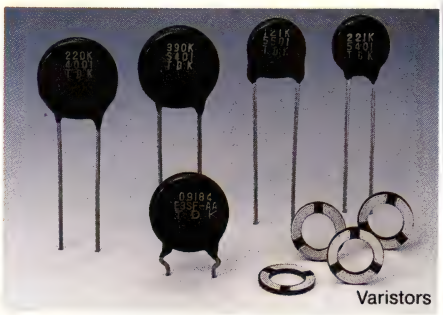
CEL is at your service. CEL, TDK's Component Engineering Laboratory in Torrance, CA, can assist you by custom designing and test manufacturing TDK EMI/RFI Components to meet your specific requirements. Call (213) 530-9397.



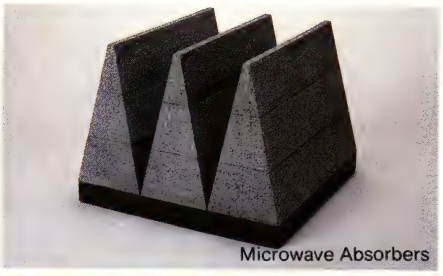
Ferrite Beads/Ferrite Chip Beads



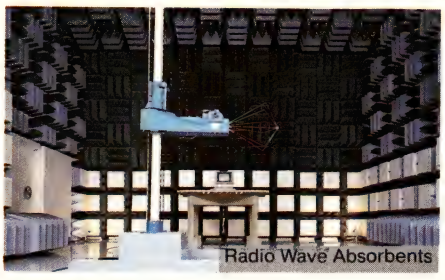
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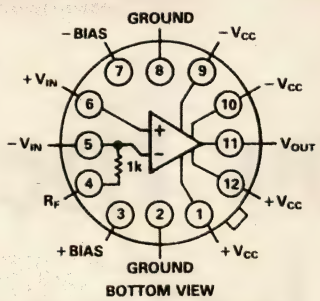
ANALOG DEVICES

Wide Bandwidth, Fast Settling Operational Amplifier

AD9611

FEATURES
- Unity Gain Stable
- Small Signal Bandwidth 280MHz
- Full Power Bandwidth 220MHz
- Settling – 13ns to 0.1%
- Offset Voltage ±0.5mV
- Bias Current ±1μA
- Power Dissipation Independent of Load

APPLICATIONS
- Driving Flash Converters
- High Speed DAC I-to-V Conversion
- Radar, IF Processors
- Baseband and Video Communications
- ATE/Pulse Generators
- Imaging/Display Applications



AD9611 Functional Block Diagram

PRODUCT DESCRIPTION

The AD9611 is a fast settling, wide bandwidth, low distortion, dc coupled operational amplifier that combines exceptional ac and dc specifications to establish a new standard of excellence. The combination provides designers with a unique solution when system speed and signal fidelity are critical.

Rise and fall times are 1.3ns. The –3dB bandwidth is 280MHz (G = ±5); full power bandwidth is 220MHz. The AD9611 settles to 0.1% in 13ns and has flat frequency response over the rated bandwidth. The design is optimized to provide low distortion over the full bandwidth, which means "clean" amplification for driving high speed flash A/D converters.

Input offset voltage is ±0.5mV with 5μV/°C drift; bias currents are typically ±1μA, and drift 75nA/°C. In most current-feedback amplifiers, bias current drifts are random. In the AD9611, inverting and noninverting bias currents drift in the same direction over temperature; this allows traditional resistor nulling for reducing effective output voltage drift.

The AD9611BH is rated for case temperatures from –25°C to +85°C; the AD9611TH is guaranteed from –55°C to +125°C. Contact the factory for information about 883 grade parts. All units are built and tested in a MIL-STD-1772 certified facility.

PRODUCT HIGHLIGHTS

1. The current-feedback architecture which is used instead of voltage feedback makes bandwidth relatively independent of gain. With G = 0, –3dB bandwidth is 310MHz; at G = ±5, bandwidth is 280MHz; at G = ±20, bandwidth is 210MHz.
2. Extremely low distortion and noise are hallmarks of AD9611 performance. A 60MHz input tone is used for 100% testing of 2nd and 3rd harmonics; they measure –54dBc and –58dBc, respectively. With a 20MHz input, they measure –67dBc and –69dBc. Exceptionally low 3rd order two-tone intermodulation distortion (IMD) makes the AD9611 an ideal choice for communications/IF applications.
3. The AD9611 requires ±5V power supplies and has an innovative current-steering output stage that keeps total circuit power dissipation essentially constant regardless of output drive (for loads ≤100Ω). *Circuit power dissipation does not increase as the load is increased;* the unit can be operated up to +110°C in still air without heat sinking.

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If your present high-speed operational amplifiers are creating performance problems in your systems, you should consider the newest standard in high-speed op amps, our AD9611.

With a –3dB bandwidth of 280MHz typical (250MHz guaranteed), the AD9611 has the widest bandwidth of any dc-coupled op amp available. And with a 60MHz input tone, the second harmonic is –54dBc, so the fidelity and distortion performance are also unmatched.

When it comes to time domain and settling time performance, the AD9611 dominates there, too. Rise and fall times are 1.3 and 1.5ns, respectively, and settling to 0.1% is just 13ns.

In addition, the AD9611 can deliver its fully rated load even in ambient temperatures of up to 110°C – unlike other high-speed op amps, which require heat sinking starting at 40°C. The AD9611 doesn't sacrifice dc performance either, since offset voltage is only 0.5mV and bias currents are 1μA.

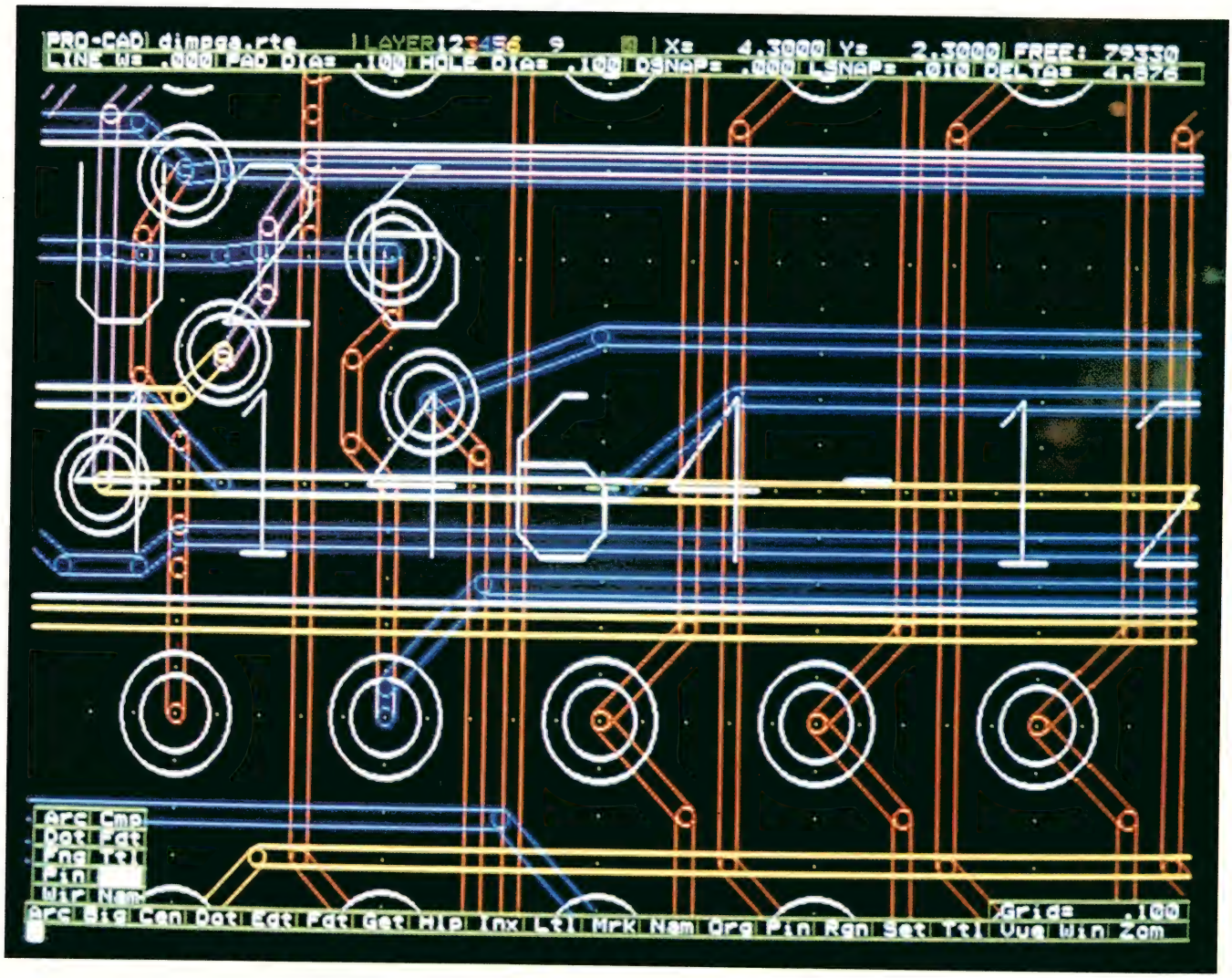
For more information on how the AD9611 provides optimum high-speed performance in dc-coupled op amps, call your nearest Analog Devices sales office.

ANALOG DEVICES

Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106; Headquarters: (617) 329-4700; California: (714) 641-9391, (619) 268-4621, (408) 559-2037; Colorado: (719) 590-9952; Maryland: (301) 992-1994; Ohio: (614) 764-8795; Pennsylvania: (215) 643-7790; Texas: (214) 231-5094; Washington: (206) 251-9550; Austria: (222) 885504; Belgium: (3) 237 1672; Denmark: (2) 845800; France: (1) 4687-34-11; Holland: (1620) 81500; Israel: (052) 911415; Italy: (2) 6883831, (2) 6883832, (2) 6883833; Japan: (3) 263-6826; Sweden: (8) 282740; Switzerland: (22) 31 57 60; United Kingdom: (932) 232222; West Germany: (89) 570050

CIRCLE NO 105

Know the territory before you buy PC-based CAE software



Doug Conner, *Regional Editor*

Depending on printed literature alone can be risky when you're shopping around for PC-based schematic capture and pc-board layout packages. The buying process is difficult because you have to match your hardware closely with your software. What's more, you should buy packages that correspond with your own typical board designs, their level of complexity, and the quirks and kinks that arise from specific design and manufacturing requirements. It's important to remember too that CAE packages, especially those designed for pc-board layout software, often push personal computers to their limits. So both in matching the hardware to the software and in matching the software to your application needs, it's the maximum capability, rather than the minimum, that most often holds the key to the right choice.

In general, it's best to explore beyond the literature on these PC-based CAE products and talk to people who have used the software for applications similar to yours. Better yet, try the evaluation packages on some of your typical designs. They're widely available, fairly inexpensive, and enormously useful in deciding which software package truly fits your needs.

Shopping for a PC-based CAD/CAE package means more than a casual browse through some published literature. There's simply too many variables involved. Knowing what the issues are and how they interrelate, along with trying some evaluation kits, can help you find the right package for your needs.

In CAE packages, automatic doesn't necessarily mean complete—or sometimes even efficient. You need to be careful when assessing the various automatic options, such as autorouters, available in most schematic capture and pc-board layout software. The more complicated your board design, the more likely it is you'll encounter irregularities and exceptions that mandate your direct intervention.

Because pc-board layout always demands more of your hardware than schematic capture does, the requirements of the layout package usually dictate your hardware configuration. (In fact, many of the schematic-capture portions of workstation CAD/CAE software run on PCs, but the pc-board layout segments do not.) If your pc-board layouts typically include 100 ICs or less (or the equivalent number of component pins), you can often perform these on an IBM PC, PC/XT, or PC/AT that has 640k bytes of memory and a color monitor with EGA resolution (640×350 dots). Beyond 100 equivalent ICs, you start running into limitations with a system of that capacity. When you start laying traces, for example, you may find yourself short on system memory and therefore unable to complete the electrical hookup of the circuit. An EGA-resolution monitor doesn't limit you as dramatically, but it can make pc-board layouts beyond 100 equivalent ICs very difficult and time-consuming. At higher levels of complexity, you can't view large portions of the layout with a resolution good enough to lay down traces.

Most vendors of CAE software for PCs free designers from these limitations by offering packages that run with hardware enhancements. **Table 1** shows the maximum RAM supported by various software packages. The Lotus/Intel/Microsoft standard for memory expansion—8M bytes of RAM—is the solution chosen by most vendors. A RAM of 8M bytes can typically handle pc boards with anywhere from 300 to 500 equivalent ICs.

The maximum display resolution that a given software package allows is another important consideration (see **Table 1**). Most packages permit the use of a 1024×768-dot color monitor; some go even further. A 1024×768-dot monitor gives a PC display the quality you generally find on a workstation. The monitor and the necessary graphics card, however, cost around $5000 extra.

Another significant consideration is how long a package takes to redraw a layout. This specification's not a simple one: The time it takes to completely redraw your design after you've emended it depends on the hardware, the software, and the complexity of a particular pc-board layout. Redrawing can take 20 secs—for more elaborate circuits, it can take a minute or more. Some hardware configurations include pan and zoom to help you view different sections of your layout quickly. If you want to take advantage of this feature, however, you must make sure your software supports it.

The integrity of your library is no problem if you are

A layout editor displaying the detail of a 4-layer design *(Electronic Design Tools Inc)*

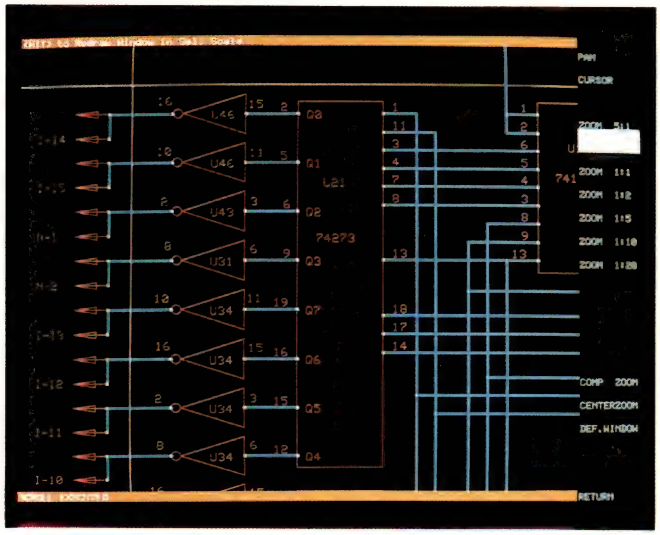
For both schematic capture and pc-board layout, the editor is the feature you use most often.

only using one PC system for schematic capture and pc-board layout. But if you have more than one computer for CAE design, you'll want to ensure that a single qualified version of each part is used in all designs. Networking does this easily by centralizing the parts library. It's the standard way of preserving the consistency of designs in the workstation world, and it's probably the most efficient way to achieve conformity in PC-based CAD/CAE systems as well. When purchasing CAE software for multiple PC systems, make sure that the software package works smoothly with the networking system you'll be using. High-speed data transfer rates are necessary to avoid slow system responses.

The editor is always critical

For both schematic capture and pc-board layout, the editor is the feature you use most often. Work with the editors vendors supply in their evaluation packages. It's really the best way to assess their ease of use. The editors in the kits usually let you explore all aspects of circuit and pc-board design (the only thing you can't do is print a design out on hard copy). Some software packages further facilitate the design and layout processes by using the same or a similar editor for both tasks. Others do not. Having to learn the special features of only one editor can save you a significant amount of time.

When evaluating editors, don't forget to try creating parts that don't exist in the libraries. Although all the vendors offer libraries, some with 3000 to 5000 parts, you'll always need to create new parts that aren't in the libraries. The process should be uncomplicated. Check to see that the software manual describes a straightforward parts-creation process in simple terms. One extra feature found on some packages lets you jump into the parts editor without leaving your design file.



Schematic capture on a PC-based system *(Visionics Corp)*

Transforming a schematic into a finished printed-circuit board involves several separate steps. First you need to define the basic mechanical outline of the board and the fixed mechanical requirements, such as card edge connectors and stiffeners. You can create the mechanical outlines either by using the pc-board layout editor, or by some other software package available for mechanical design. If you plan to use the pc-board layout editor, however, make sure that it has all the flexibility you need. Your design may need circular boards, for example, and not all layout editors accommodate them.

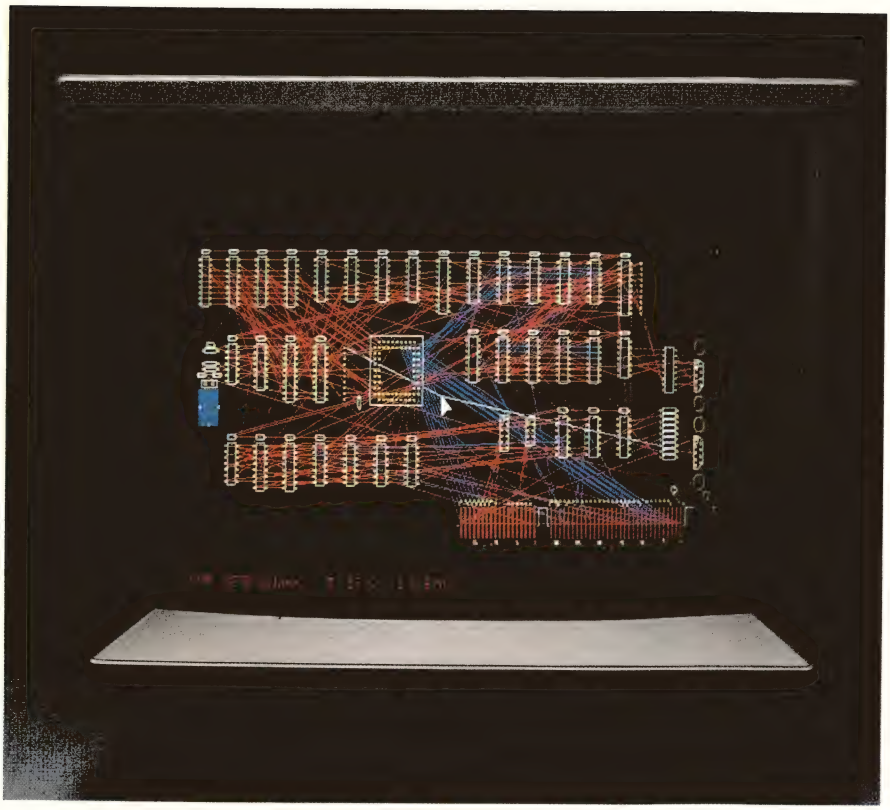
Next you need to start actually placing parts. Placement can be manual or automatic. Either way, it's critical to a good routing job. The majority of vendors offer some type of autoplacement tool to assist in parts placement. These tools usually don't create acceptable parts placements, but they do perform the useful task of putting the necessary components on screen. You can then place the parts directly by moving them to the desired position rather than having to call each part up out of the library.

Perhaps the most valuable tool for parts placement lets you view a board's rat's nest so that you can see where and how long the connections are. You can then move components to minimize connection lengths. Also you can often choose to view a rat's nest for the entire board, the nets associated with a specific IC, or the net connected to a single pin.

Don't expect too much from autorouters

Once you have what you think is an acceptable placement of parts, it's time to try routing the board. Autorouters can help but they're limited. Three different levels of autorouters are commonly available for PC-based systems. The simplest ones route two layers at a time. If you are using more than two signal layers, however, you may want to improve efficiency by using a multilayer router, so named because it can route more than two layers at once.

The third level of sophistication is rip-up-and-retry routers. If one of these latter routers cannot connect a



A rat's nest for viewing connections *(Accel Technologies)*

network within the design-rule constraints you specify, it rips up previously routed traces that are blocking the new trace and tries to route them differently. Although all autorouters require a significant number of computations and therefore demand lots of computer time, rip-up-and-retry packages are the most voracious users of computer power. If you want to use one of them, you should seriously consider a system with a high-performance processor, such as the Intel 80386 or Motorola 68020. **Table 1** shows how many layers various autorouters can handle simultaneously.

Regardless of their particular capacities for routing layers simultaneously, autorouters in general deserve a couple of cautionary notes. First, the quality of autorouters is uneven—it's highly dependent on the depth of the programmers' knowledge of pc-board layout when they write their programs. Also the three groups functionally overlap: Don't just assume that all multilayer autorouters are better than 2-layer ones, or that rip-up-and-retry routers are better than both. Your application may not in fact require the highest level of sophistication.

Completion rates are contingent on several variables: the size and density of the board, the parts placement, the design rules you are working under, and how good your autorouter is. In any event, you'll probably reach the best approximation of a package's completion rate by trying the software on a pc-board design that's typical of your requirements. Some vendors include their autorouters in their evaluation packages for this purpose.

If an autorouter can't achieve at least an 80% completion rate, you'll spend as much time editing the autorouted traces to finish the board as you would routing the entire board manually on the computer. Completion rates above 90% are really best. But even if the autorouter runs to 100% completion, your troubles may not be over.

For one thing, an autorouter sometimes adds more vias than you would need if you routed the board manually. And if the autorouter used six layers where you could manually route the board on four, you're going to pay an increased manufacturing cost throughout the production run of the board. Autorouters may also require fine-line technology (two traces between IC pads) for high completion rates instead of the one trace

Text continued on pg 154

TABLE 1—REPRESENTATIVE PRODUCTS COMBINING SCHEMATIC CAPTURE AND PC-BOARD LAYOUT ON PERSONAL COMPUTERS

		SYSTEM CONFIGURATION			PC-BOARD DESIGN	
MANUFACTURER	PRODUCT CONFIGURATION	COMPUTER	MAXIMUM RAM (BYTES)	MAXIMUM DISPLAY RESOLUTION (DOTS)	MAXIMUM NUMBER OF LAYERS	MAXIMUM NUMBER OF NET OR CONNECTIONS
ACCEL TECHNOLOGIES	TANGO-SCHEMATIC, PCB, ROUTE, TOOLS	IBM PC/XT/AT, PS/2	640k	640×350	8 ELECTRICAL	15,000 CONNECTIONS
ADVANCED MICROCOMPUTER SYSTEMS	PC-SCHEM, PRO, ROUTE	IBM PC/XT/AT, PS/2	640k	640×350	256	4000 NETS
APTOS SYSTEMS	RGRAPH	IBM PC/XT/AT, PS/2	640k+LIM[2]	1024×768	50	10,000 NETS
CAD SOFTWARE	PADS-CAE II, PCB, LARGE, SUPERROUTER, GERBER	IBM PC/XT/AT, PS/2	640k+LIM[2]	1024×768	30	2000 NETS
CADDY	ELECTRONICS AUTOROUTER 1/80	IBM PC/XT/AT, PS/2	640k+LIM[2]	1280×1024	128	—
CALOS	CALOS 6000	IBM PC/XT/AT, PS/2	640k+LIM[2]	1024×768	30	2000 NETS
CASE	VANGUARD DESIGN SYSTEM	IBM PC/XT/AT, PS/2	640k+LIM[2]	1024×1024	150	RAM DEPENDENT
DOUGLAS ELECTRONICS	SCHEMATIC, PROFESSIONAL LAYOUT, AUTOROUTER	APPLE MAC II (R)[1]	2M (R)[1]	1024×768	>100	RAM DEPENDENT
ELECTRONIC DESIGN TOOLS	PROCAD, AUTOROUTER	IBM PC/XT/AT	16M	1024×768	55	10,000 NETS
INTERACTIVE CAD SYSTEMS	JUMBO PACK	IBM PC/XT/AT, PS/2	640k+LIM[2]	1280×1280	50	2000 NETS
OMATION	SCHEMA, CAE	IBM PC/XT/AT, PS/2	640k+LIM[2]	1024×768	30	2000 NETS
ORCAD	SDT III, PCB	IBM PC/XT/AT, PS/2	640k	1280×1024	16 ELECTRICAL	2000 NETS
PERSONAL CAD	MASTER DESIGNER	IBM PC/XT/AT, PS/2	640k+LIM[2]	1024×768	100	2500 NETS
RECAL-REDAC	CADSTAR	IBM PC/XT/AT, PS/2	640k	1280×960	16 ELECTRICAL	3500 CONNECTIONS
VAMP	McCAD EDS	APPLE MAC II (R)[1]	2M (R)[1]	1024×768	>32	RAM DEPENDENT
VISIONICS	EE DESIGNER III	IBM PC/XT/AT, PS/2	640k+LIM[2]	1284×1024	36	64,000 CONNECTIONS
WINTEK	HIWIRE-PLUS	IBM PC/XT/AT, PS/2	640k	640×480	256	

NOTES: 1. (R) = RECOMMENDED.
2. LIM = LOTUS/INTEL/MICROSOFT EXPANDED MEMORY.
3. INCLUDES 68020 COPROCESSOR BOARD WITH HIGH-RESOLUTION GRAPHICS DRIVER.

			AUTOROUTER			TOTAL PRICE
MAXIMUM NUMBER OF EQUIVALENT ICs (EICs) OR COMPONENTS	FEATURES	MAXIMUM PC-BOARD SIZE (IN.)	SIMULTANEOUSLY ROUTED LAYERS	MINIMUM GRID SIZE (MILS)	FEATURES	
350 EIC	CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×19	2	25	KEEP OUT AREAS, POWER AND GROUND PLANES	$1780
1000 COMPONENTS	CONNECTIVITY CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	2	20	KEEP OUT AREAS, POWER AND GROUND PLANES	$500
400 EIC	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	64×64	2	5	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$6700
400 EIC	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	12	10	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES, RIPUP AND RETRY	$7000
300 EIC	BACK ANNOTATION, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	90×90	16	12.5	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$3190
400 EIC	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	12	12.5	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES, RIPUP AND RETRY	$11,075
4000 COMPONENTS	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	16	1	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES, RIPUP AND RETRY	$12,500
RAM DEPENDENT	RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	16	1	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$2900
3000 COMPONENTS	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	>64×64	2	GRID-LESS	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$10,900[3]
400 EIC	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	64×64	2	1	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$1420
400 EIC	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	2	10	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$2695
130 EIC	CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	2	5	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$1990
500 EIC	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	32	1	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$16,980
511 EIC	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	2	10	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$9850
RAM DEPENDENT	CONNECTIVITY CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	2	1	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$1495
>1000 COMPONENTS	BACK ANNOTATION, CONNECTIVITY CHECK, DESIGN-RULE CHECK, RAT'S NEST, SURFACE-MOUNT TECHNOLOGY	32×32	26	25	REENTRANT, KEEP OUT AREAS, POWER AND GROUND PLANES	$3995
150 EIC	CONNECTIVITY CHECK, DESIGN-RULE CHECK, SURFACE-MOUNT TECHNOLOGY	60×60	—	—	—	$895

Whether parts placement is manual or automatic, it's critical to a good routing job.

between pads needed for manual routing. In cases such as these, you have to weigh pc-board design costs, manufacturing costs, and time to market to know what's right for you.

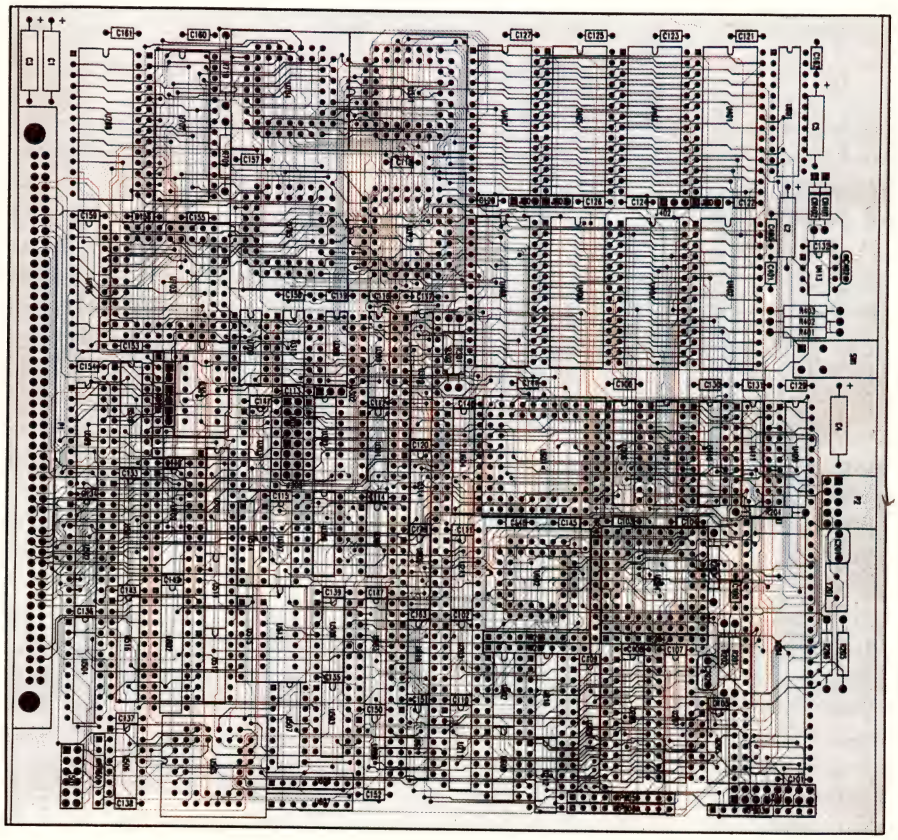
Fig 1 shows what an autorouter can achieve. The Super Router from CAD Software completed 100% of the routing automatically in 13 hours. The pc board has one hundred sixty 14-pin equivalent ICs on 4 signal layers with 2 layers for power and ground. In general, however, autorouters can't compensate for a designer's lack of knowledge about pc-board layout, but in the right hands, good packages can be productive tools. What constitutes a good autorouter for your application often depends on the complexity of the boards you route and on any special requirements you might have. If you have a very stringent design, you might find that even an autorouter on a workstation is inadequate.

Use reentrant autorouters for efficiency

Many autorouters are reentrant, which means you can stop and restart them during the routing process. Thus you can modify unsatisfactory routing interactively. Some autorouters also let you designate portions of a board for autorouting. If an autorouter is not reentrant, you can't interrupt it to modify traces until it has completed its routing pass. Prerouting, however, is normally possible—you can usually route any special requirements or difficult traces before the autoroute begins.

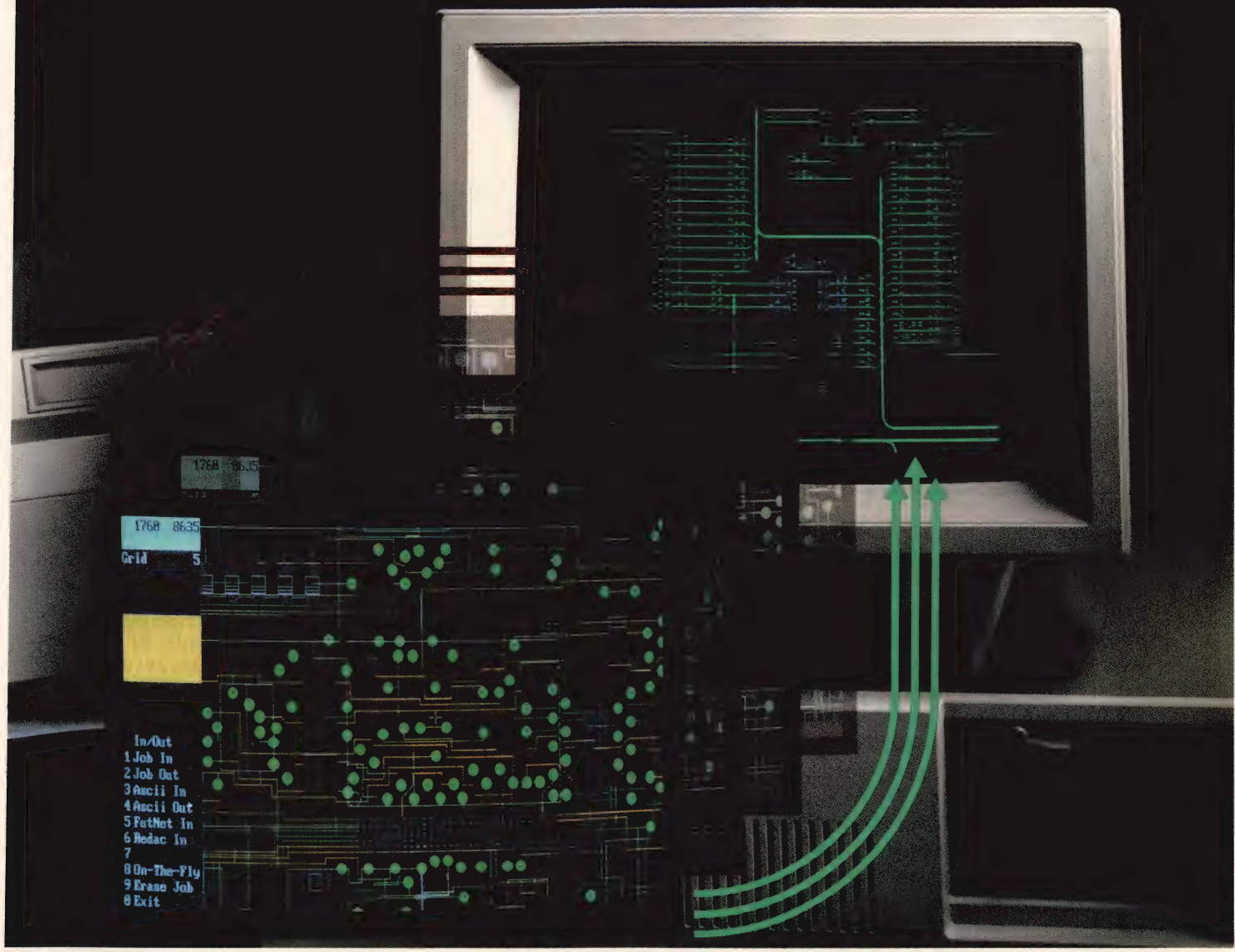
Another useful feature available on most autorouters is the ability to earmark resticted (or keep-out) areas. The feature varies somewhat from package to package: Some restrict all routing from designated areas. Others may also let you circumscribe areas where traces are allowed but vias aren't. When you have a design that doesn't permit vias under ICs, you may find this feature quite useful.

Most autorouters normally work on a basic grid spacing; some are virtually gridless. Depending on the design rules you're using, you may need a finer grid than some packages offer with their autorouters (see **Table 1**). Routing surface-mount pc boards typically demands finer grid spacing than does through-hole design. On the other hand, all of the representative



This pc-board layout was 100% autorouted in 13 hours *using CAD Software's Super Router. An automatic process for manufacturing optimization took another 12 hours. The layout contains the equivalent of one hundred sixty 14-pin ICs and is routed on 4 signal layers plus 2 layers for power and ground. Total pc-board area is 64 square inches.*

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For more information . . .

For more information on the schematic-capture and pc-board layout packages described in this article, contact the following manufacturers directly, circle the appropriate numbers on the Information Retrieval Service card, or use EDN's Express Request service.

Accel Technologies Inc
7358 Trade St
San Diego, CA 92121
(619) 695-2000
Circle No 370

Advanced Microcomputer Systems Inc
2780 SW 14th St
Pompano Beach, FL 33069
(305) 975-9515
Circle No 371

Aptos Systems
10 Victor Square, Suite 200
Scotts Valley, CA 95066
(408) 438-2199
Circle No 372

CAD Software Inc
119 Russell St
Littleton, MA 01460
(617) 486-9521
Circle No 373

Caddy Corp
Three Crossroads of Commerce
3401 Algonquin Rd, Suite 340
Rolling Meadows, IL 60008
(312) 394-7755
Circle No 374

Calos Inc
3419 Edison Way
Fremont, CA 94538
(415) 657-4430
Circle No 375

Case Technology Inc
2141 Landings Dr
Mountain View, CA 94043
(415) 962-1440
TLX 506513
Circle No 376

Douglas Electronics
718 Marina Blvd
San Leandro, CA 94577
(415) 483-8770
Circle No 377

Electronic Design Tools Inc
1950 Stemmans Freeway
Dallas, TX 75207
(214) 224-2472
Circle No 378

Interactive Cad Systems
2352 Rambo Ct
Santa Clara, CA 95050
(408) 970-0852
Circle No 379

Omation Inc
1210 E Campbell Rd
Richardson, TX 75081
(214) 231-5167
Circle No 380

Orcad Systems Corp
1049 S.W. Baseline St
Suite 500
Hillsboro, OR 97123
(503) 640-5007
TWX 910-240-2090
Circle No 381

Personal CAD Systems Inc
1290 Parkmoor Ave
San Jose, CA 95126
(408) 971-1300
TLX 3717199
Circle No 382

Racal-Redac Inc
238 Littleton Rd
Westford, MA 01886
(617) 692-4900
Circle No 383

Vamp Inc
6753 Selma Ave
Los Angeles, CA 90028
(213) 466-5533
TWX 650-262-3069
Circle No 384

Visionics Corp
343 Gibraltar Dr
Sunnyvale, CA 94089
(408) 745-1551
TLX 346352
Circle No 385

Wintek Corp
1801 South St
Lafayette, IN 47904
(317) 742-8428
Circle No 386

packages offer 1-mil (or finer) grid spacing for laying out designs manually on the computer.

Surface-mount technology not only requires finer grid spacing, it also makes other special demands on autorouters, so don't just assume that because the package says it supports surface-mount devices, it can satisfy your particular manufacturing requirements. SMT manufacturing specifications dictate that traces only leave pads at prescribed points and in specific directions. Your design may need blind and buried vias, for example, or it may specify that components be mounted on both sides of the pc board.

Be careful too when vendors tell you they have autorouters for power and ground planes. Some packages treat those planes just like signal planes. Other packages can route true power and ground planes with power and ground pins tied into their respective solid-copper planes and clearance holes on all the other pins.

All vendors offer, either customarily or optionally, utilities to convert pc-board layouts to the industry-standard Gerber photoplotting format. You can thus plot out the Gerber format file on a standard plotter to proof it. A good review at this point usually uncovers errors that might otherwise go undetected until several hundred dollars worth of photoplots have been made.

Automatic checking saves time

PC-board layout software can also perform connectivity and design-rule checks. The connectivity check makes sure that the board layout matches either the schematic or the net-list derived from the schematic. The design-rule check looks for several problems, the most common of which are pad-to-pad, pad-to-trace and trace-to-trace clearance violations. If an autorouter is included in the package, it typically incorporates the connectivity and design-rules check into its process, running them all simultaneously; however when you route or modify routes manually, the checks can verify independently connections and your adherence to design rules. Some of these independent checks operate in real time as you design; others run as postprocessing tasks.

After you finish the pc-board layout, you need to back annotate the schematic to correct the reference desig-



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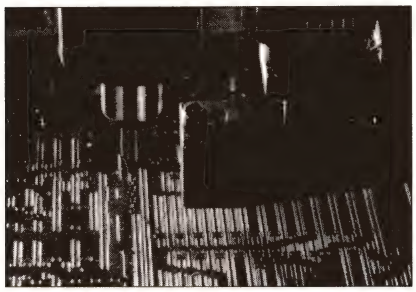
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BoardMaker is revolutionary because it costs *one-sixth* the price of first generation prototype machines—and literally pays for itself after about a dozen boards. For more information, call (415) 883-1717 or use the reader card.

lbc

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CIRCLE NO 108

nators on all the originally assigned layout components. Among other things, you need to assign pinouts for any gates that have been grouped into specific ICs during the layout process. Automatic back annotation can be both fast and accurate, but some exceptions can still arise. If, for convenience, you used a spare NAND gate somewhere instead of an inverter, for example, back annotation probably won't handle it automatically. Most of the time, however, back annotation can help keep your schematic and pc-board layout in close agreement.

It's the possible exceptions of various types that make trying evaluation kits a good rule to follow. All the integrated CAD/CAE packages for the PC perform the basic schematic capture and pc-board layout functions necessary for ordinary designs. The problems arise when circuits become complex. And you can't understand how a package deals with such deviations until you actually try its programs.

For example, when designing a board with 2 signal planes plus a power and ground plane, you may occasionally elect to route signal traces on the power or ground plane to get around obstructions rather than using more signal layers. You won't know how easy or difficult this is to do—or if you can do it at all—unless you actually try it with an evaluation kit.

Most applications bring their own unique set of problems to the drawing board. Designing with ECL is a case in point. Many packages claim to support ECL, but you can't just assume that an autorouter will put pull-down terminations at the destination rather than randomly along the length of the connection. Finding a package that satisfies all your requirements and is easy to work with requires some in-depth research. By testing the evaluation packages, you should also be able to see just how bug-free the software is.

Of course, in the end, the CAD/CAE package you choose should be a total solution to your problem. The trend is toward integrated packages, and this certainly can make your life easier. If the various programs don't mesh smoothly with one another, both forward from schematic capture to pc board layout and backward from layout to annotating schematics, the design process will be inefficient. It never pays to have a roaring fast autorouter that leaves you performing back annotation manually. **EDN**

Article Interest Quotient (Circle One)
High 473 Medium 474 Low 475

VF Technology... The Bright Decision

Futaba, a world leading manufacturer of vacuum fluorescent displays, offers a wide assortment of *display tubes* in many sizes and formats. Also, Futaba offers *display modules* with all the electronics required to refresh the display and easily interface with the host system.

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GRAPHIC DISPLAYS/MODULES

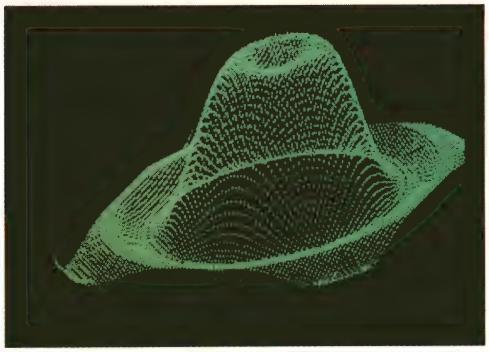
Futaba Display	Futaba Module	Pixels (Row X Char.)	Brightness (FT-L)	Module Dimensions (in.)
GP1005B	GP1005B03	128X64	400	7.28X3.35X1.77
GP1006B	GP1006B04	256X64	200	9.84X3.35X1.77
GP1009B	GP1009B03	240X64	200	6.2X2.76X1.57
GP1010B	GP1010B01	176X16	200	7.32X2.16X1.70
GP1002C	GP1002C02	320X240	100*	7.10X6.30X1.60
GP1004B	GP1004B03	640X400	30	9.65X7.28X1.85

*Different Versions Available

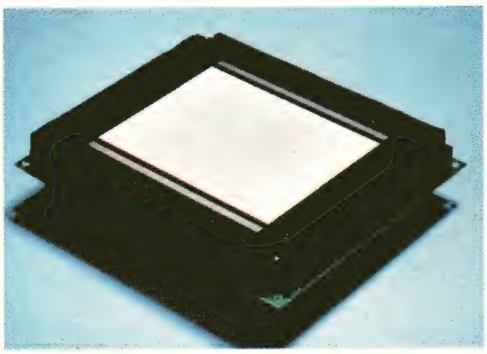
DOT MATRIX DISPLAYS/MODULES

Futaba Display	Futaba Module	Char. X Row	Dot Format	Char. Ht. (in.)	Module Dimensions (in.)
20SD01Z	M20SD01	20X1	5X7	0.200	6.3X1.97X.75
20SD42Z	M20SD42	20X1	5X12	0.344	7.1X2.16X.88
40SD02Z	M40SD02	40X1	5X7	0.200	9.45X2.16X.88
40SD42Z	M40SD42	40X1	5X12	0.344	9.45X2.16X.88
202SD03Z	M202SD03	20X2	5X7	0.200	6.7X2.56X.90
402SD04Z	M402SD04	40X2	5X7	0.200	10.43X2.56X.90

MANY OTHER DISPLAYS **NEW MODULES AVAILABLE SOON**



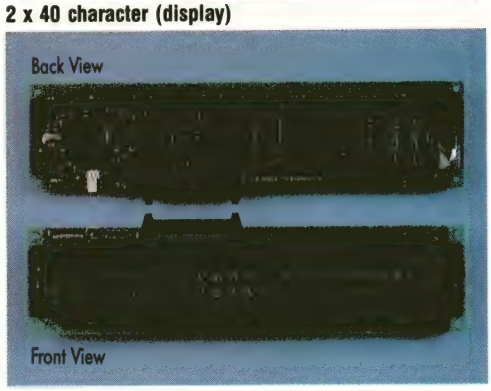




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"What if...

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Look, HP's gone through the same thing. Our own divisions deal with the same problem daily. We came up with a solution called DesignCenter. It combines our electronic design automation tools with the rest of the process to produce a high degree of manufacturability right from the start—in design."

"That's exactly what we need. A single data path from design right on through production and out the door. If we could somehow combine electronic design with microprocessor development and mechanical engineering and tie it into manufacturing and test, we'd be a lot happier. Are you saying HP can do that for us now?"

"We're not there 100% yet. Nobody is. But that's the whole idea behind our DesignCenter. Right now, we've got the broadest set of EDA tools there is. Match them up with the HP test and measurement tools you've used for years, and you'll be way ahead of the game."

"We've always counted on HP test equipment. But how does that relate to your EDA tools?"

"We were able to bridge the gap between design and prototype test. Now you can create higher quality tests—faster, too—by transferring data directly between our logic analyzers and simulation. And the design and layout tie directly into HP board test systems."

"That's terrific. But testing is only one part of the process. We're making decisions on everything from ASICs and PLDs to microwave hybrids to multi-layer PCBs. And they all have different parts and technologies. I'll tell you, it's impossible to keep up."

"We agree, it's a big problem. But that's the reason we have digital, analog, and microwave CAE tools for design, simulation, and layout. We even support it all with information management to handle the tough tradeoffs your team has to make in choosing between all the technologies and complex interactions."

"There's one thing that's always a concern. We've got systems in here from some of your competitors. If we go with HP, can you fit into our existing environment?"

"Absolutely. Using either off-the-shelf or customized interfaces, we'll help you integrate HP tools into your existing systems. And, since HP supports EDIF and IGES standards, you'll have the flexibility you need down the road."

"Speaking of standards, tell me about your platforms."

"Well, HP is among the industry leaders in standardization because the marketplace is demanding it. Our family of workstations and servers supports UNIX and networking standards. They thrive in a multi-vendor environment, making it easier to get your job done right the first time. That's the bottom line these days."

"I get the feeling you understand that we're interested in a lot more than just tools. I mean, you seem to be talking about more than hardware and software."

"I am. HP is totally committed to this idea of getting more correct-by-design products through your plant. We *are* talking about a lot more than the tools. We'll sit down with you and help create a system that meets your needs . . . not ours or somebody else's. And I mean we'll get right down to solving problems and training your people. That's what we do better than anyone else."

"I want to keep talking about this whole thing. And I want to include some other engineers, too. What are you doing next Wednesday?"

"I've got a feeling I'll be back here."

"Right."

"Name a time."

The dialogue continues . . .

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- Flexible interactive software provides fast programming generation.

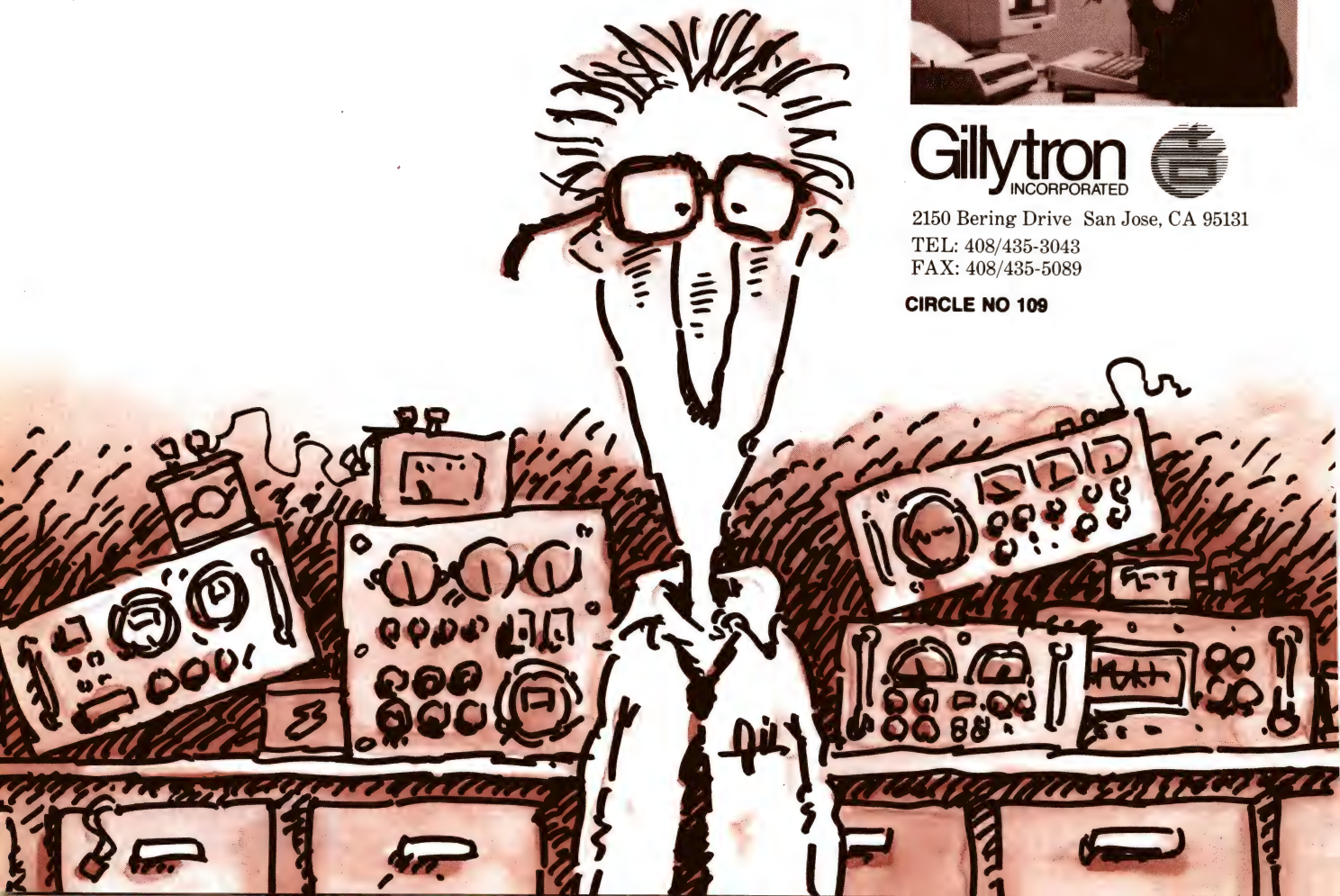
At $125,000, the DV6005 is not only inexpensive at the beginning, it is a stand-alone system that can be *expanded directly to an automated wafer-, device- or board-production tester—with 1792-pin capability.*



Gillytron INCORPORATED

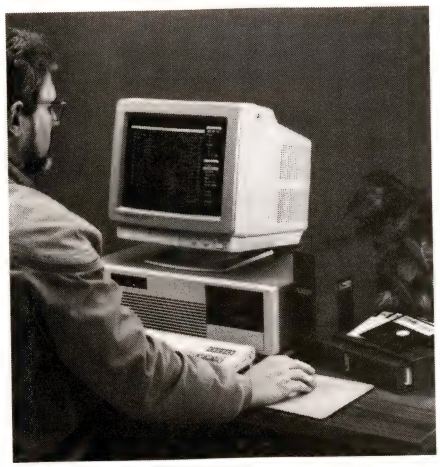
2150 Bering Drive San Jose, CA 95131
TEL: 408/435-3043
FAX: 408/435-5089

CIRCLE NO 109



Software package relieves designer of physical details of ASIC design

You can avoid dealing with the physical design details of ASIC design if you use IC Works software to create the devices. Once you've completed the schematic capture and design verification, the computer handles the rest of the design process automatically, from cell placement through routing, clock generation, and rule checking. The complete package (including the schematic capture, cell libraries, and validation tools) sells for $10,000. The software requires an IBM PC/AT or compatible running MS-DOS, a color monitor with an EGA card, a hard disk, and a mouse.



The cell library for IC Works is based on a 2-μm, double-metal CMOS process and offers over 100 entries. You can add RAM, ROM, and PLA structures to your design simply by specifying their configuration and any necessary programming. You can also define custom cells by using the building blocks in the library. The library is not proprietary, so you can take your final design to any foundry you wish.

The package imposes certain restrictions: You must use synchronous design techniques, and design size is limited to about 5000 gates. However, the company offers a $5000 prototype fabrication service and guarantees that the resulting devices will perform as simulated.

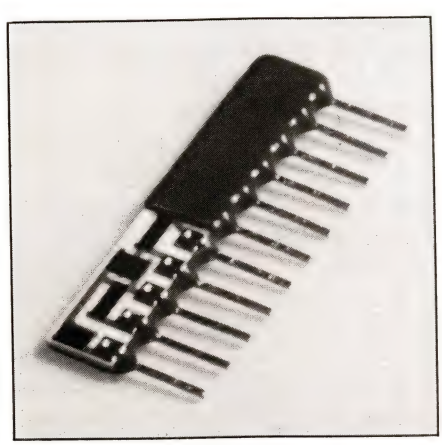
IC Designs, 12020 113th Ave NE, Kirkland, WA 98034. Phone (206) 821-9202. TLX 4949856.

Circle No 351

CAD package allows you to design resistor networks on a PC

The Resicalc CAD program for IBM PCs and compatibles not only allows you to design semicustom resistor networks, it also provides dial-up access to quotations, delivery information, and order-placement facilities. Because the program incorporates the company's resistor-network-design rules, it gives instant feedback as to whether your design is manufacturable.

The program allows you to design either single-in-line-packaged networks with leadouts suitable for through-hole or surface mounting, or networks that are packaged in a surface-mount leadless carrier. Having selected a package type, you can specify such package parameters as number of pins, lead pitch, maximum height, and type of passivation.



To specify the network's electrical parameters, you enter each resistor's absolute value, absolute tolerance, tolerance relative to another specified resistor, absolute temperature coefficient, temperature coefficient relative to another specified resistor, and maximum power dissipation. The last step is to define the network's internal electrical connectivity.

The company supplies Resicalc free-of-charge on an IBM PC-compatible disk.

Ericsson, Business Area Components, Box 98, 56300 Granna, Sweden. Phone 39011020.

Circle No 354

Ericsson Components, 3255 Scott Blvd, Suite 4D, Santa Clara, CA 95054. Phone (408) 988-3603.

Circle No 355

Microwave design workstation handles complex IC logic design

The MMIC Design Workstation is a hardware/software system that provides designers of microwave and mm-wave ICs with comprehensive CAE facilities, including schematic capture, linear and nonlinear simulation, full-custom layout, and design verification.

The hardware can be either an Apollo DN 3000/4000 or a Sun 3 workstation that provides multitasking capabilities and network communications via Apollo's Token Ring system or Ethernet.

The Design Entry tool creates a schematic that captures all relevant information about your design, and makes this information available to the other tools of the system. Simulation tools, which include Libra/Touchstone and Microwave Spice, provide facilities for all types of simulation from linear and nonlinear frequency-domain analysis to nonlinear time-domain analysis. Other simulation models include GaAs MESFET models; you can also use MMIC element models from foundries such as Triquint Semiconductor and Harris Microwave Semiconductor. Prices range from $35,000 to $150,000.



EEsof, 5795 Lindero Canyon Rd, Westlake Village, CA 91362. Phone (818) 991-7530. TLX 384809.

Circle No 352

Workstation helps in designing packaging for electronic products

Package Station consists of an Apollo DN3000 workstation with 4M bytes of memory, a 19-in. color monitor, and a set of software tools specifically designed to help you design the packaging for your electronic products. Links to the vendor's pc-board-design and -layout system facilitate the exchange of information between board designers and package designers.

The graphics editor provides a combination of "multiview dynamics" and a "workplane" that makes it easy for you to visualize and construct 3-dimensional models. You can use any combination of views for your work, including the isometric view. The ability to move the workplane to any surface of the model makes 3-D design as easy as 2-D.



You can change views, zoom in or out, or execute any other command without affecting a previously initiated command sequence that is currently in progress.

The Autotherm thermal-analysis module is intended for package designers and therefore handles mesh generation and refinement automatically—you don't need any understanding of the finite-element analysis (FEA) techniques that the module employs. If you integrate the Package Station with the vendor's pc-board-design and -layout tools, you can perform thermal analysis of the boards that are to go into your package after component placement, but before the board design is committed to routing. Package Station costs $54,900.

Mentor Graphics, 8500 SW Creekside Pl, Beaverton, OR 97005. Phone (503) 626-7000. TLX 160577.

Circle No 353

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"ASICs CREATE A SET OF TEST PROBLEMS WE NEED A WHOLE NEW



VHOLE NEW
)OESN'T THAT MEAN
'EST STRATEGY?"



IT SURE DOES.

It's easy to see that the tremendous potential of ASICs has only just begun to be tapped. What's not so evident is the fact that developing these unique ASIC devices carries with it some unprecedented test problems. Problems that traditional test approaches and traditional ATE simply are not equipped to handle.

At ASIX Systems our focus has always been exclusively on ASICs. From the start we recognized the unique ASIC test problems. That's why we took an entirely different approach to solving these problems. For instance, we saw that adapting existing ATE to fit the needs of ASICs didn't make sense. Designing a totally new, focused ASIC test system did. Test programs needed to be automated, developed from the design data base, and simple to change. The test system itself needed to be easy to use, designed for its particular environment, and a cost-effective alternative to the huge, expensive, complicated ATE.

TEST SOLUTIONS FOR THE WHOLE ASIC COMMUNITY.

Our unique perspective allowed us to understand that the ASIC world is not Design Engineers, Test Engineers and Quality Engineers performing separate functions. It's actually a "community" of specialists whose tasks are intrinsically linked. So we made sure that we could provide another crucial element. Communication. In order to capture the vital time-to-market edge, what ASIC designers and vendors really need is the opportunity to use the same test programs and the same tester. Because when both environments are working from a common frame of reference there can be some real communication about test results. That's a whole new way of looking at ASIC testing. That's the ASIX-1 family of test systems.

ASIX-1: ASIC TEST SYSTEMS THAT MAKE SENSE.

This isn't the place to tell you everything the ASIX-1 family has to offer. But here are a few things to think about: automatic, menu-guided programming; data base management; ATE architecture and flexibility at an affordable cost; 256 true I/O pins; "zero footprint"; fully integrated PMU; automatic calibration; simple fixturing; no cabling; high MTBF. Enough. You get the point. You really ought to see the ASIX-1 for yourself. And the sooner the better. ASIX Systems Corporation • 47338 Fremont Blvd • Fremont, CA 94538.

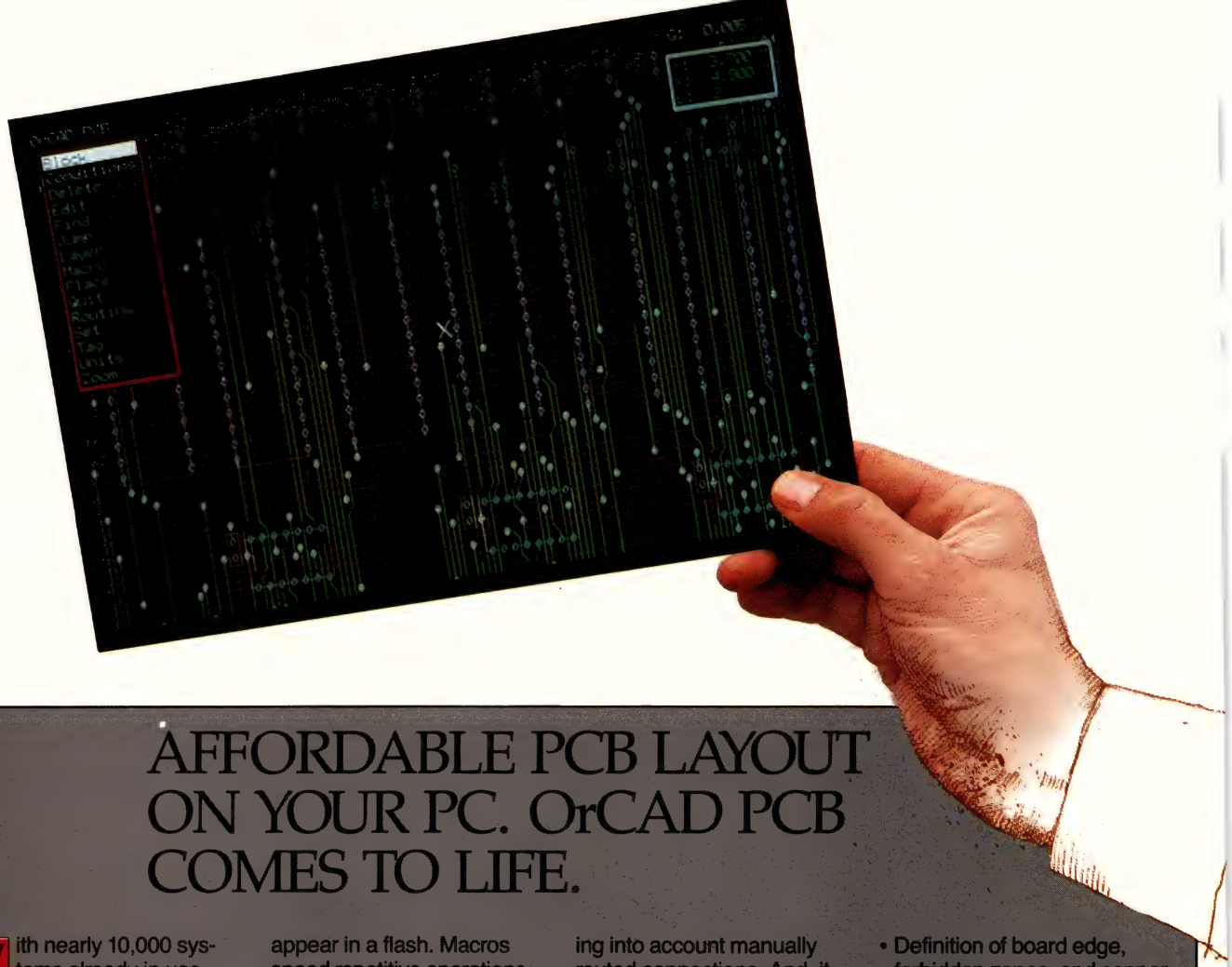


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CIRCLE NO 113



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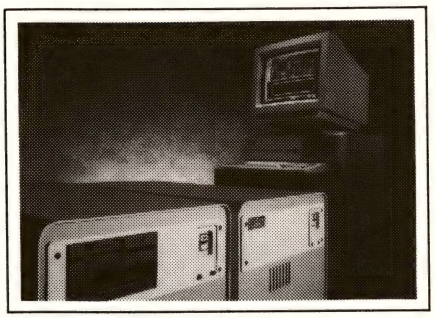
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OR8801-I



ACCELERATOR

The GigaLogician hardware accelerator simulates large, electronic system designs that contain a mixture of switch, gate, behavioral, and physical models. The accelerator's parallel architecture incorporates two distinct types of processors: hardwired processors that accelerate switch- and gate-level tasks; and microcoded processors that accelerate both behavioral-simulation tasks and input from the vendor's PMX physical modeler, which fits into the accelerator's chassis. The smallest accelerator configuration has one hardwired and two microcoded processors, and can handle designs that have as many as 96,000 primitives (40,000 to 80,000 gates); you can add processors to simulate designs of as many as 256,000 primitives. Base configuration, $180,000; each additional hardwired processor, $45,000; each additional microcoded processor, $20,000.

Daisy Systems Corp, Box 7006, Mountain View, CA 94043. Phone (415) 354-4486. TLX 858262.

Circle No 575

EDA NETWORKING

The Access software package allows you to configure network systems of EDA (Electronic Design Automation) software applications. When you use the software, the vendor's EDA tools become network resources that are available to each user on the system. If you need a schematic-capture tool, you can check it out from the server, use it at your workstation node, and then return the software to the server. The package runs on Sun systems and costs $1000/node. Prices of the vendor's EDA tools range from $4500 to $12,500.

Valid Logic Systems, 2820 Orchard Parkway, San Jose, CA 95134. Phone (408) 432-9400.

Circle No 578

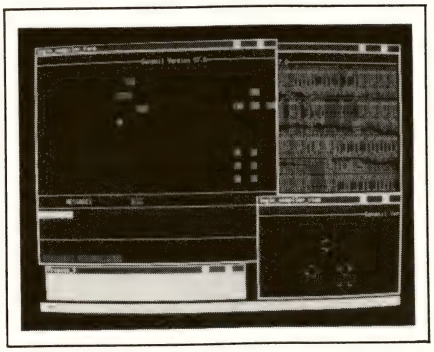
LOGIC SYNTHESIS

The XC-DS23 Automated Design Implementation software allows you to combine schematics and PLD equations into a programmable gate-array net list, and then automatically place and route the resulting design. The software automatically minimizes the logic and eliminates unused elements. The program then partitions the combined net list into logic-cell-array resources—logic and I/O blocks.

Various optimization techniques allow you to optimize the design for the smallest area, the highest performance, or a combination of both. You can use the program to optimize all or any part of a design; the primary use of the synthesis tool is the optimization of PLD designs that are included in a programmable gate array. $1500.

Xilinx, 2069 Hamilton Ave, San Jose, CA 95125. Phone (408) 559-7778. TWX 510-600-8750.

Circle No 579



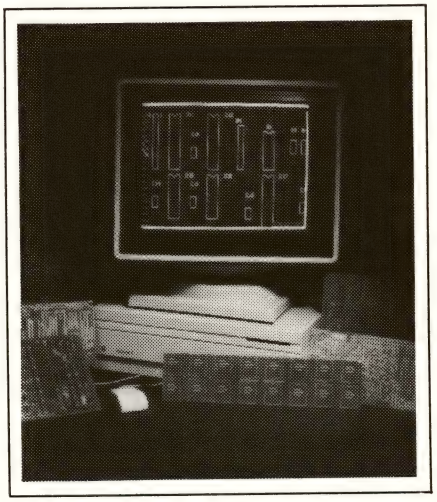
ASIC DESIGN TOOLS

The ATG and LogicCompiler product options are now available for use with the vendor's Genesil 7.0 IC-design system. ATG (Automatic Test Generation) comprises a set of software tools that provide automatic test-vector generation, test analysis programs, and fault grading. You can use these tools for sequential circuits as well as for RAMs, ROMs, and combinatorial circuits.

LogicCompiler automatically synthesizes the IC layout from a net list of predefined functional primitives that the system has generated from your design. LogicCompiler uses pattern-recognition techniques and rule-driven logic synthesis to compress the overall logic, thereby reducing the number of gates needed to perform the functions your design specifies. It then automatically compiles the optimized circuitry into standard cells. You can define the aspect ratio of the cells and the I/O pinout, and interactively explore physical design alternatives until you are satisfied with the IC layout and routing. ATG, $39,500; LogicCompiler, $24,500.

Silicon Compiler Systems Corp, 2045 Hamilton Ave, San Jose, CA 95125. Phone (408) 371-2900.

Circle No 576



CAE FOR MACINTOSH

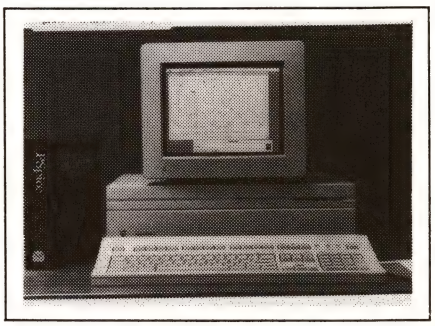
The Professional System electronic CAD system runs on the Macintosh and consists of three upgraded modules: Professional Layout, Schematic, and AutoRouter.

Schematic 1.3 now includes busing, three modes of simulation, a tool palette similar to that of

MacDraw, Boolean-formula generation from the circuit diagram, and the ability to create multipage schematics. Professional Layout 5.3 can now print ground planes with shorting bars, and its new menu helps you construct a variety of shapes in different orientations. The program lets you design boards as large as 32×32 in. and has features that make surface-mount designs easy. AutoRouter 1.3 is a maze router controlled by a command file. You can now interrupt routing in order to edit the layout, and then restart the routing at any point. The program lists unroutable connections in a text file, as well as displays them on the screen as rat's nest lines. Professional Layout, $1500; Schematic and AutoRouter, $700 each.

Douglas Electronics Inc, 718 Marina Blvd, San Leandro, CA 94577. Phone (415) 483-8770.

Circle No 577



PSPICE FOR MAC

PSpice, a widely used simulator of analog electrical circuits, is now available for the Macintosh II computer. The product was originally introduced for the IBM PC, PC/XT, PC/AT and compatibles. In the new version, each transistor needs approximately 2.5k bytes of memory; the maximum size of the circuit to be simulated is limited only by the amount of memory available on the Macintosh II.

The program obtains maximum execution speed through the use of the Macintosh II's 68881 floating-point coprocessor. The Monte Carlo Analysis and Device Equations options are also available for the Macintosh—but in order to use the Device Equations option you will also need the Aztec C compiler from Manx Software Systems (Shrewsbury, NJ). PSpice, $1450; Monte Carlo and Device Equations options, $550 each; probe and parts options, $700 each.

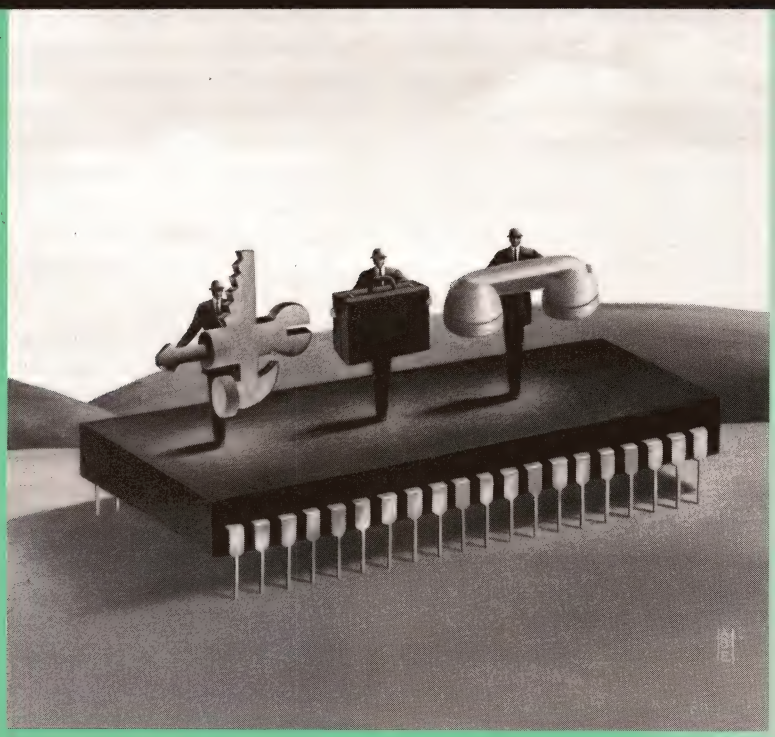
MicroSim Corp, 23175 La Cadena Drive, Laguna Hills, CA 92653. Phone (714) 770-3022. TLX 265154.

Circle No 580

ANALOG SIMULATOR

The ECA-2, an analog simulator for electronic circuit analysis, is now available for all Macintosh models. The program can perform ac, dc, transient, Fourier-transform, temp-

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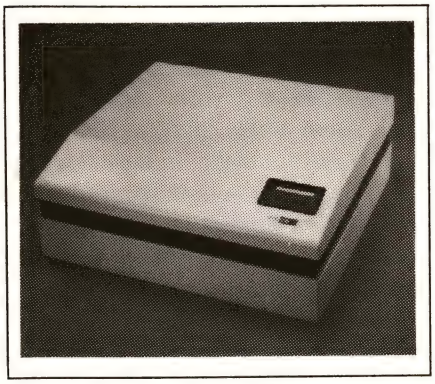
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erature, worst-case, and Monte Carlo analyses; according to the vendor, EC-2 simulations execute more than twice as fast as the corresponding Spice simulations. The program also provides extensive nonlinear capabilities, Spice-compatible models, and function generators for sine, pulse, piece-wise linear, single-frequency frequency modulation, and exponential signals. You can use the program interactively or in batch mode. The ECA-2 costs $675; the EC-Ace, a subset of ECA-2 that can't perform Fourier transforms, worst-case, or Monte Carlo analyses, and that lacks some other advanced features of ECA-2, costs $145.

Tatum Labs Inc, 1478 Mark Twain Court, Ann Arbor, MI 48103. Phone (313) 663-8810.

Circle No 581



PHOTOPLOTTER

The P15 is a photoplotter for use with IBM PC/ATs and compatibles. It has a 300×400-mm horizontal flatbed printing surface with vacuum holding. The plotter provides a resolution of 2.5 μm, a positioning accuracy of 25 μm, and a repeatability of 25 μm. The proprietary optical head can provide 32 fixed symbols, each driven by a separate LED source in the head. The drawing speed is 25 mm/sec max, and the flashing speed is 500 pads/minute max. The plotter accepts standard RS-274 Gerber codes via the vendor's S15 driver and will work with any Gerber-formatted codes. The plotter consumes 200W (without vacuum pump) at 110/220V ac, 60/50 Hz, single phase. The unit is housed in a table-top enclosure measuring 730×675×265 mm, and it weighs approximately 70 kg. SFrs 38,500.

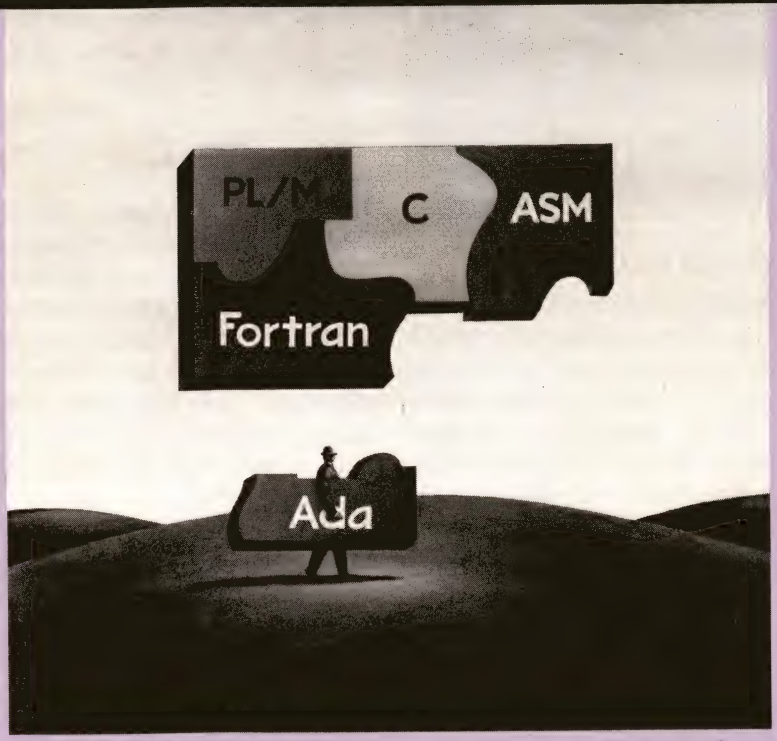
Electronic Industrial Equipment SA, 15 rue Eugène-Marziano, CH-1211 Geneva 24, Switzerland. Phone (022) 42 32 60. TLX 429484.

Circle No 584

OPTIMIZING SIMULATOR

Optimizing HSpice is a multitarget optimizer that works with all Spice and HSpice models. The program optimizes dc currents for models, capacitance for ac analysis, and transient parameters for transient analysis. New features include Monte Carlo, Pole Zero, and Mixed-Domain analyses; S-parameter out-

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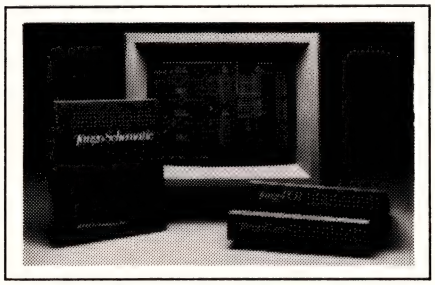
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put; instantaneous and rms power plotting; a multigamma model for MOS 6 Level; and an improved BSIM model. The simulator runs on a variety of workstations and mainframes. From $1500 to $90,000, depending on the host.

Meta-Software Inc, 50 Curtner Ave, Suite 16, Campbell, CA 95008. Phone (408) 371-5100. TWX 910-350-4928.

Circle No 582



SCHEMATIC CAPTURE

Tango-Schematic version 2 incorporates major enhancements over the previous version. Among the new features are a menu-driven, schematic-library manager; on-screen browse that lets you preview library components before placing them on a schematic; faster postprocessing of schematics; and drivers for Epson LQ 10- and 15-in. printers, as well as HP QuietJet and ThinkJet printers. A bit-map editor provides a simple way to draw arcs and lines and to modify individual pixels. A sort facility can automatically sort library components in alphanumeric order. $495.

ACCEL Technologies, 7358 Trade St, San Diego, CA 92121. Phone (619) 695-2000.

Circle No 586

GERBER-FILE EDITOR

The PCGerber-III program allows you to load any Gerber file on an IBM PC/AT or compatible, display the image on the screen, and verify the validity of the conversion from your CAE system to the Gerber format required by a photoplotter. If you find errors, you can correct them with the built-in graphics editor. You can check and modify D-codes as well as traces and pads, working on all layers of the design at the same time. The editor lets you view, analyze, query, measure, move, or copy any portion of the design; you can add text, generate statistics reports, and save the modified file. An optional program called GPlot generates check plots on a laser printer; the program uses a software rasterizer and can plot most files in less than 30 seconds. PCGerber-III, GPlot, $495 each.

CAD Solutions Inc, 2880 Zanker Rd, Suite 103, San Jose, CA 95134. Phone (408) 943-1610.

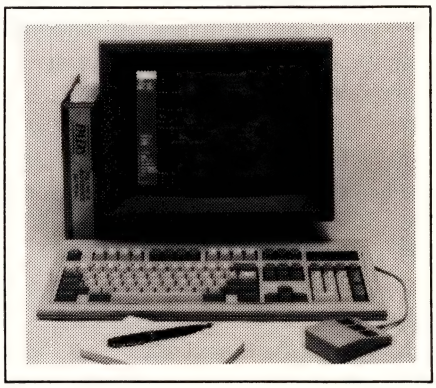
Circle No 583

CAE SYSTEM

The Master Designer 386 CAD/CAE system runs on 80386-based computers as well as on 80286-based PCs. The system runs faster and handles board designs two to three times larger than can its predecessor, the PCB-3; the system also includes a multilayer routing feature that yields a higher completion rate than the PCB-3 does. According to the vendor, this feature reduces the number of vias by 30 to 50%, as well as lessens the number of unconnected subnets. An ECO (Engineering Change Order) processing feature provides both forward annotation of logic changes and history-independent back annotation. The design database can contain data on as many as 500 equivalent ICs, 32,000 pins, and 2500 nets. The system lets you use surface-mount technology, with blind and buried vias. Menus with explicit prompts and messages guide you through the logical progression of tasks in the design process. Other features include support for Novell/3Com Ethernet networking, a network-comparison utility, and extensive checking of your design against your engineering design rules. The system works with 60 different printers and plotters. $16,980.

Personal CAD Systems Inc, 1290 Parkmoor Ave, San Jose, CA 95126. Phone (408) 971-1300. TLX 371-7199.

Circle No 592



RIP-UP AUTOROUTER

Pads-Superrouter is a 3-pass autorouter for use with the vendor's Pads-PCB layout module and Pads-CAE schematic-capture module. The first pass attempts to route all connections; if it fails, a rip-up and reroute pass follows. The third pass optimizes the routing for ease of manufacture by removing bends and unnecessary vias, and by rearranging tracks for ease of wave soldering. You can select and route from 2 to 12 layers simultaneously during a pass; you can select the grid size so as to obtain one, two, or three traces between IC pads. Traces, pads, and air-gaps can measure anywhere from 1 to 250 mils. You can also control the routing strategy by setting the relative routing costs of pin channels, vias, direction changes, and other parameters. $4500.

CAD Software Inc, Box 1142, Littleton, MA 01460. Phone (617) 486-9521.

Circle No 588

SURFACE DESIGN

ICAD Surface Designer uses knowledge-based technology to design curved surfaces. The software captures the derivation process of a surface, and thereby allows the system to automatically derive modified, trimmed surfaces. You can develop comprehensive know-

How To Wring Workstation-Level PCB Designs Out Of Your PC.



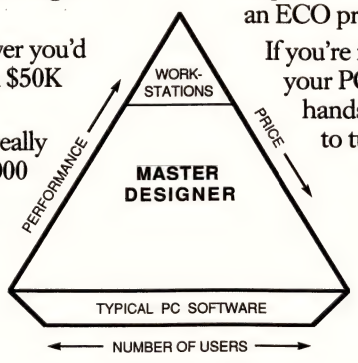
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P-CAD's Master Designer routes multiple layers simultaneously cutting the number of vias and unrouted subnets in half. So, you'll wring out cleaner designs and higher completion rates (up to 100%).



For forward annotation of logic changes and "history independent" back annotation, Master Designer also has an ECO processing option.

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CIRCLE NO 115

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ICAD Inc, 1000 Massachusetts Ave, Cambridge, MA 02138. Phone (617) 868-2800. TWX 910-250-1190.
Circle No 585

IC DESIGN TOOL

Solo-1200 runs on a variety of desktop workstations—including the IBM PC/AT, Sun, Apollo, and DEC units—and allows you to design mixed analog/digital ICs. The package provides circuit description via schematic capture or use of the Model hardware-description language; switch-level simulation; fully automatic placement and routing; and test-vector generation. To ensure design integrity throughout the design process, the package also contains a design manager that requires you to adopt good design practice.

The system comes with a set of device libraries that include analog functions, gate-level and MSI-level components, 74LS family components, parameterized macros, and functional equivalents of the company's SystemCell standard-cell library. The analog functions include 8-bit A/D and D/A converters, multiplexers, op amps and comparators, oscillators, and voltage references. The digital functions include compacted, high-complexity RAM blocks; the vendor will soon offer the library with ROM and PLA blocks. A system that runs on an Apollo or Sun workstation, £29,000.

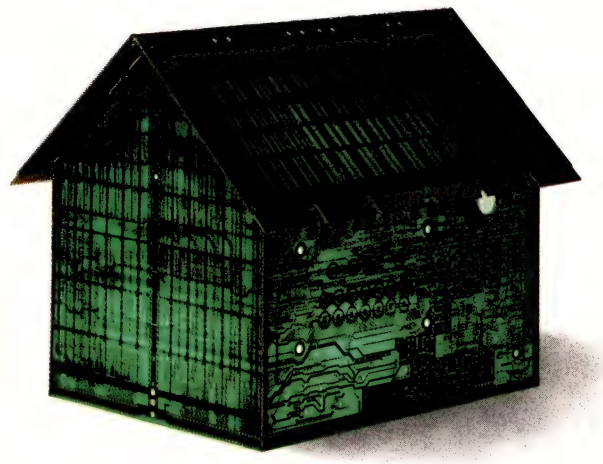
European Silicon Structures Ltd, Mount Lane, Bracknell, Berkshire RG12 3DY, UK. Phone (0344) 525252. TLX 847724.
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AUTOROUTERS

CADdy Autorouters Models 1/40 and 1/80 provide autorouting of pc boards as large as 7×7 ft with 4 or 16 layers. The autorouters run on the IBM PC, PC/XT, PC/AT, and compatibles that have at least 512k bytes of RAM, an arithmetic coprocessor, and an IBM EGA or com-

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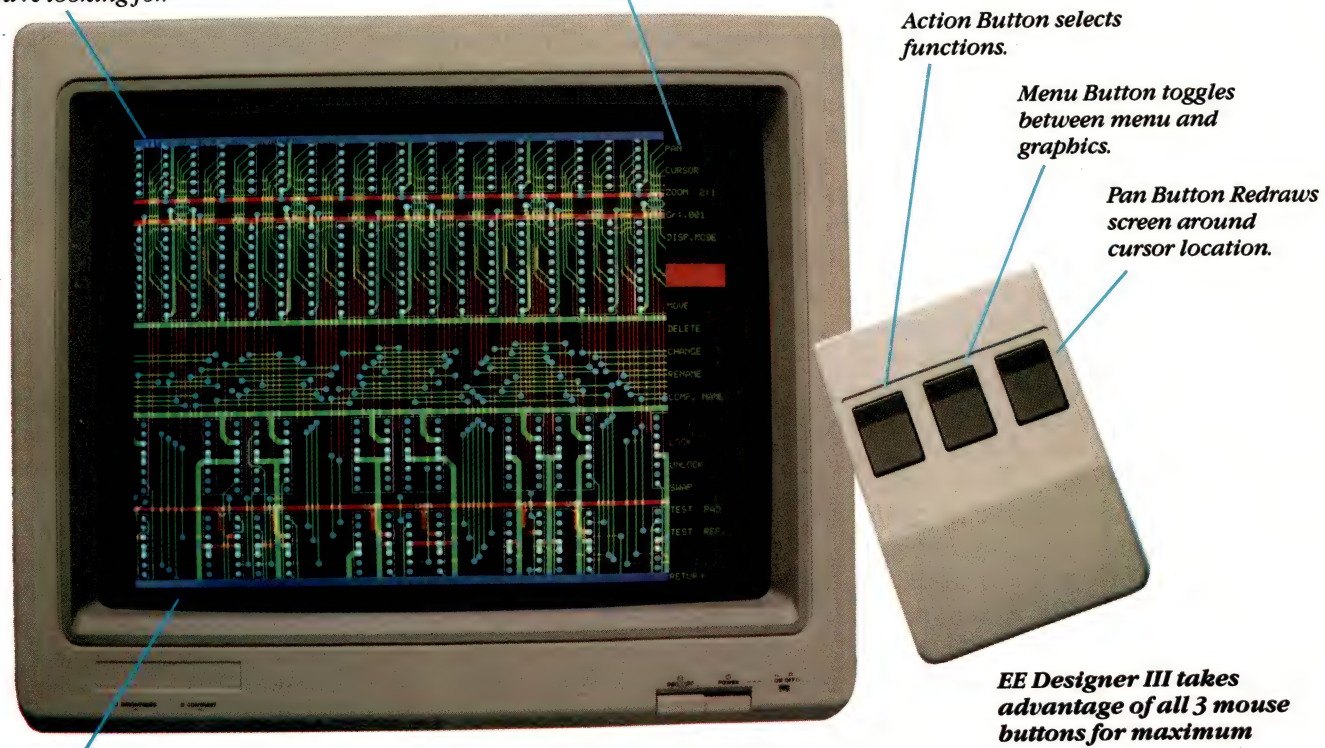
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CIRCLE NO 117

patible graphics card. They can provide routing resolutions of 100, 50, 25, or 12.5 mils; the internal resolution for component or pad placement is 1.5 mil. You can display the board in two windows simultaneously: one shows the whole board, and the other an enlargement of a selected area. The programs will route as many as 65,000 straight-line interconnects if you have sufficient memory. You can define keep-out areas for both traces and vias, or for vias only. You can perform the routing in batch mode or can display routing on the screen as it occurs. Both programs accept net-list data from the vendor's schematic-capture and simulation programs. Model 1/40, $795; Model 1/80, $1295.

CADdy Corp, 3401 Algonquin Rd, Suite 340, Rolling Meadows, IL 60008. Phone (312) 394-7755.

Circle No 590

PC-BOARD CIM

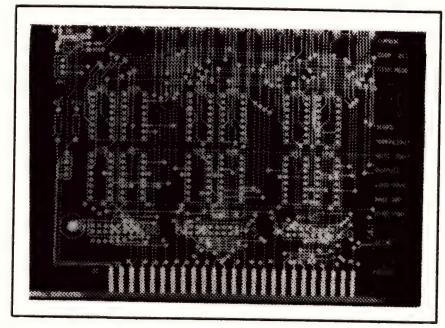
Maestro is a computer-integrated manufacturing (CIM) system for designers and manufacturers of pc boards. The system is based around a DEC VAX or MicroVAX computer that is networked to IBM PC/AT workstations with 1024×768-pixel monitors and a high-speed, graphics-display list processor board.

The system's design path lets you specify the technology in which you're designing the board—for example, SMD or Mil-Spec. The system then retrieves the appropriate components, design rules, and manufacturing specifications to ensure that the board is designed accordingly. When performing schematic capture, the system accepts net lists in a variety of formats, such as EDIF and the company's Executive CAD format. A proprietary net-list format allows you to integrate your own design tools into the system.

The autoplacement and autorouting algorithms include user-definable constraints: routing by region, signal, or component; and optimization for numbers of vias, pc-board layers, directions, turn points, and margins. The system outputs files to drive photoplotters, N/C drills, and board-cropping machines, and also parts lists and net lists. From SFr 52,000.

EIE Electronic Industrial Equipment SA, 15 rue Eugène-Marziano, 1211 Geneva 24, Switzerland. Phone (022) 423260. TLX 429484.

Circle No 596



CAE/CAD SOFTWARE

EE Designer III is a greatly enhanced version of the vendor's EE Designer II CAE/CAD software package for use on the IBM PC, PC/XT, PC/AT, and compatibles. This version has a new user interface that provides an on-screen prompt line and works with a 3-button mouse. The graphics have been enhanced to allow resolution of 1284×960 pixels, in conjunction with the vendor's graphics adapter; the software will also work, at lower resolutions, with IBM EGA and CGA or fully compatible graphics boards. You can use as much as 2M bytes of above-board memory; this memory conforms to the LIM specification. The system handles boards of 32×32 in. max with 36 layers max and provides grids of 1 mil min; therefore, you can use it for surface-mount designs.

The package consists of a number of integrated modules for schematic capture, pc-board layout, autorouting, analog or digital simulation, symbol-library management, and postprocessing to generate a wide variety of output formats including Gerber and N/C formats. The symbol libraries supplied with the package include TTL, CMOS, SMT, and analog component libraries. $3995.

Visionics Corp, 343 Gibraltar Drive, Sunnyvale, CA 94089. Phone (408) 745-1551. TLX 346352.

Circle No 587

CAE FOR GATE ARRAYS

The LCA-MDS151, a low-cost schematic-capture package, runs on the IBM PC, PC/XT, PC/AT, and compatibles. It features an enhanced version of the SDT-III schematic editor from OrCAD and XACT, the vendor's design editor for programmable gate arrays. The library consists of OrCAD's library of 3700 parts and the vendor's own programmable-gate-array macro library of TTL and standard-logic-family equivalents. You enter your schematics with the aid of the editor, using the library of gates and macros; a software translator converts the schematics into specifications for working programmable gate arrays. Pop-up menus and English-like commands make the system easier to use. The system provides five levels of zoom and automatic pan, 16 user-configurable colors, and more than 100 keyboard macros. If you don't need the entire system, you can purchase the LCA-MDS152, which consists of the schematic-capture editor without XACT. LCA-MDS151, $4950; LCA-MDS152, $1850.

Advanced Micro Devices Inc, Box 3453, Sunnyvale, CA 94088. Phone (408) 732-2400.

Circle No 594

ASIC-DESIGN TOOL

ChipCrafter is an ASIC-design toolset that runs on Apollo Domain 3000 or 4000 workstations. It provides fully automatic physical-design (place and route) processing on the engineer's workstation; you can apply the processing to the full chip from the schematic or to subblocks

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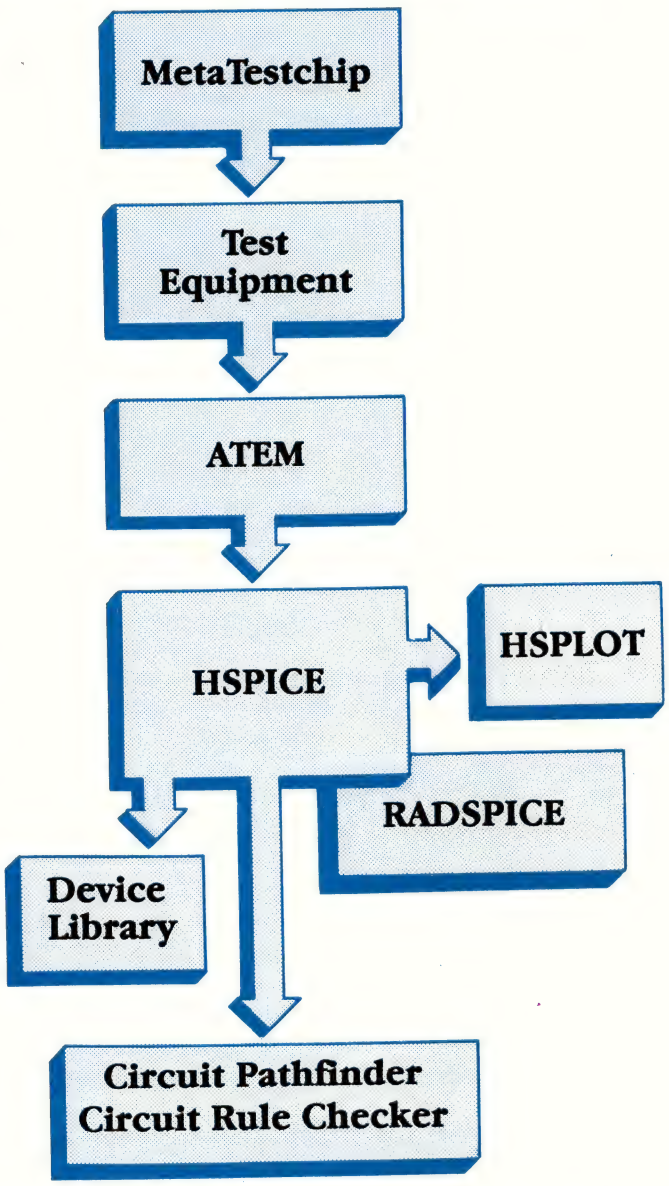
Discrete Device Library (DDL): Includes more than 750 models of discrete components for use with HSPICE. Included are BJT, MOSFET, HEXFET, Diode, JFET, Op Amp. Comparator, A/D converter, D/A converter, Timer and SCR models.

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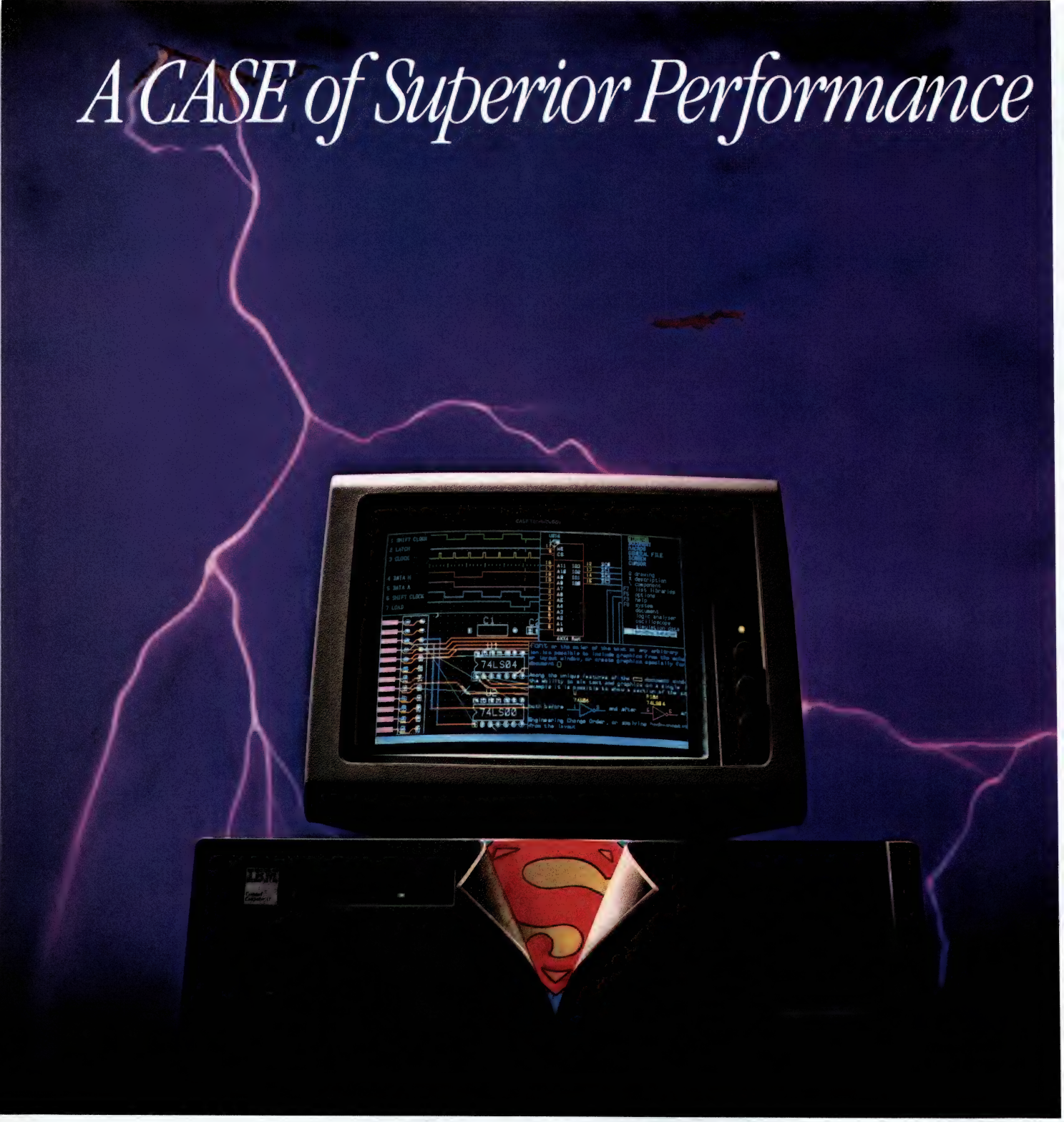
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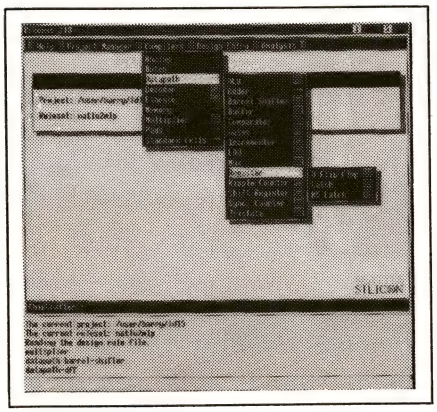
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Seattle Silicon, 3075 112th Ave NE, Bellevue, WA 98004. Phone (206) 828-4422.

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ASIC EXPERT SYSTEM

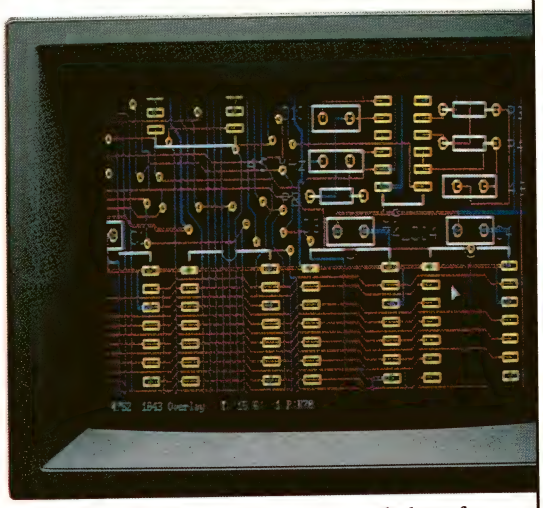
Knowledge Consultant is a software tool that lets you graphically capture your design expertise in a knowledge base. The vendor's Logic Consultant expert system can employ the knowledge base to optimize your ASIC logic designs by reducing propagation delays and decreasing the gate count. Using the built-in graphics editor, you first draw an "antecedent" circuit using foundry-specific, component-library symbols; then you draw the "consequent" circuit, a less obvious but more efficient circuit that provides the same functionality. You also define the port mapping between the two circuits. The knowledge compiler then verifies that the two circuits are logically identical, and determines the speed and area factors for each. If the knowledge you are adding is all ready in the knowledge base, the program informs you; otherwise, it compiles the knowledge into the knowledge base. The software tool runs on a Mentor Graphics (Beaverton, OR) workstation. $49,500.

Trimeter Technologies Corp, 200 Hightower Blvd, Suite 100, Pittsburgh, PA 15205. Phone (412) 787-8630. TWX 510-601-3773.

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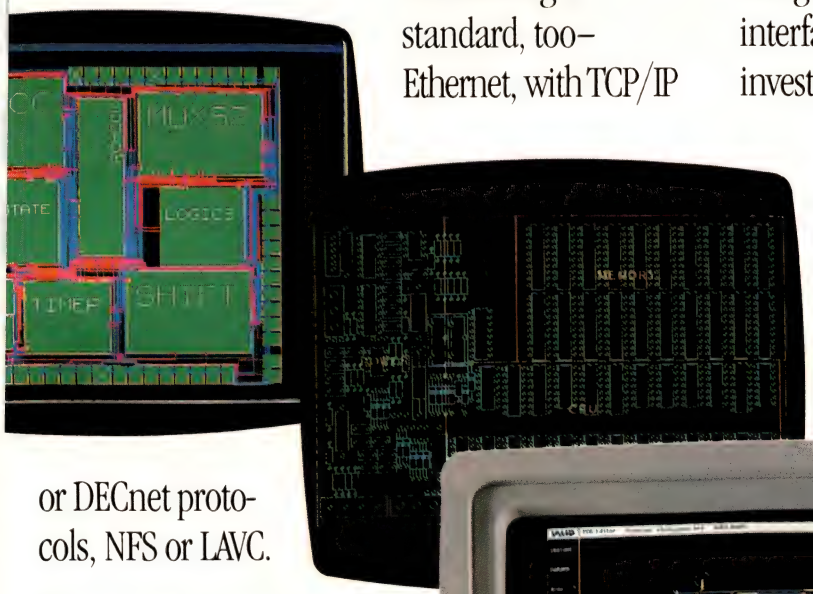
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Feature-packed universal programmers deliver good value



Dan Strassberg, *Associate Editor*

Picture the following situation: Your device programmer can program any sort of programmable logic device (PLD) or read-only memory device that exists today or ever will exist. When new device families and new fabrication technologies emerge, your programmer can handle them without hardware modifications. When you're not using the programmer to program devices, you can run your favorite word processor, database manager, or spreadsheet on it. This scenario may sound like science fiction, but don't lose heart: Although you're not likely to find a programmer with all of these attributes just yet, the programmer industry is within striking distance of delivering products with most of these features and many others as well.

Programmer prices range over nearly two orders of magnitude. Universal programmers—ones that handle PROMs, EPROMs, EEPROMs, and a wide variety of PLDs, as well as μPs that incorporate onboard PROMs—begin at less than $2000 (for a PC-based unit, not including the computer). You can spend much more for some universal programmers, but for a substantially smaller sum you can purchase any of a large class of programmers dedicated to devices of a single type (or a few types).

Because the price range is so wide, making an intelligent purchase clearly requires an understanding of the available products and their cost/benefit tradeoffs. You'll need to know, for example, what premium you'll pay—at the time of purchase and afterward—for programmer universality. You must also consider whether the universal programming instrument you choose is likely to have the capability you'll need a couple of years down the road. For example, will a higher-priced product prove less expensive in the long run than one with a lower purchase price, or would you be wiser to purchase capability that exactly matches your current requirements and nothing more? This article will help you to formulate questions to ask potential suppliers; their answers will enable you to decide what kind of product best meets your needs.

When talking to potential suppliers, be aware that among programmer manufacturers there is no universal agreement on the meaning of the word "universal." The inclusion of that term in an instrument's description is not a guarantee that the instrument can program a particular IC. The only way to be certain that a programmer supports a specific device is to check the programmer vendor's latest list of supported parts. Nevertheless, instruments that carry the "universal" moniker are more versatile than other programmers. If such a programmer doesn't support all of the devices you want to use, the chances are good that its vendor can make it do so.

Universal programmers—ones that handle a wide variety of programmable logic devices in addition to PROMs, EPROMs, EEPROMs, and programmable μPs—fall at or near the top of most vendors' lines. How much is the security blanket of universality worth? To answer, you must closely examine both the programmers and your requirements.

Many universal programmers can automatically determine the type of device you've inserted and invoke the appropriate algorithms. Before programming a device, most programmers verify that the device is both blank and good, and they make sure that you've connected the part correctly. After programming, some programmers apply a set of test patterns to determine whether the device meets all of its static and dynamic performance requirements.

In fact, programmers, particularly those that program logic elements such as PLDs, are increasingly beginning to resemble automatic device-test systems, albeit small and highly specialized ones. At least one vendor, Logical Devices, has announced the intention to offer software that lets you use a universal programmer as a low-cost tester for nonprogrammable devices.

Many architectural differences distinguish the universal programmers discussed here (**Table 1** lists a representative sample). These differences reflect the designers' differing views of the relative importance of a number of features. For example, some programmers have within them all of the intelligence they need for operation. They also include keypads and alphanumeric displays, so you don't need an external terminal to use them. But most such programmers do provide an

Parametric-testing programmer that links to device handler *(Oliver Advanced Engineering Inc)*

Consider what premium you'll pay for programmer universality, and whether your instrument will have the capability you need a few years down the road.

TABLE 1—REPRESENTATIVE UNIVERSAL PROM/PLD/μP PROGRAMMERS

VENDOR	MODEL	PERSONALITY MODULES	PC-BASED[1]	LIBRARY UPDATES	US BASE PRICE[2]	COMMENTS
ADAMS-MACDONALD ENTERPRISES	SPRINT PLUS	NO	YES	DISK	$1795	
	PROMAC 11	YES	NO	EPROM	$3195	
ADVIN SYSTEMS INC	SAILOR-PAL	NO	YES	DISK	$1695	PRICE IS FOR A UNIT THAT SUPPORTS PROMs AND PLDs
BYTEK CORP	135-U	YES	NO	EPROM	$1895	CAN PERFORM GANG AND SET PROGRAMMING; PC-BASED SUPPORT SOFTWARE IS AVAILABLE
CYPRESS SEMICONDUCTOR INC	QUICKPRO	NO	YES	DISK	$995	LIST OF EXPLICITLY SUPPORTED DEVICES INCLUDES ONLY THE VENDOR'S UNITS
DATA I/O CORP	29B	YES	NO	EPROM	$7500	
	UNISITE 40	NO	NO	DISK	$11,995	REQUIRES ASCII TERMINAL; USES PACKAGE ADAPTERS, ONE OF WHICH ALLOWS SET AND GANG PROGRAMMING
DIGELEC INC	DIGIPACK 5 (MODEL UP-803)	YES	NO	EPROM	$6950	USES PACKAGE ADAPTERS; FIRMWARE IS IN PERSONALITY MODULES; INCLUDES CRT DISPLAY
DIGITAL MEDIA	IQ180/280	NO	NO	DISK	$2495	FOR 28 PINS—IQ180
					$2995	FOR 40 PINS—IQ280
GTEK INC	9000/7344	NO	YES[3]	DISK	$1593	PROM AND PLD PROGRAMMERS SOLD IN COMBINATION
INLAB INC	28A/U	NO	NO	EPROM	$2795	$2495 WITHOUT 128k-BYTE RAM EXPANSION
INTEL CORP	iUP-PC	YES	YES	DISK	$1500	PERSONALITY MODULES COST $350 TO $495
LOGICAL DEVICES INC	PROMPRO SUPER 8X	NO	NO	EPROM	$1995	USES EXTERNAL TERMINAL OR KEYPAD/DISPLAY UNIT
	ALLPRO	NO	YES	DISK	$2795	28-PIN VERSION
OLIVER ADVANCED ENGINEERING	OMNI 28	NO	NO	VIA RS-232C TO BATTERY-BACKED RAM	$3250	ALL UNITS REQUIRE AN EXTERNAL TERMINAL OR PC; INTERNAL MODEM AND HIGH-SPEED SET-PROGRAMMING ADAPTERS ARE AVAILABLE
	OMNI 40	NO	NO		$4450	
	OMNI 64	NO	NO		$5650	
SHERMAN PIRKLE INC	8608	NO	NO	EPROM	$3500	YOU CAN EXPAND RAM TO 512k BYTES
STAG MICROSYSTEMS INC	PPZ	YES	NO	PLUG-IN FIRMWARE "PAKS"	$8865	INCLUDES 256k BYTES OF RAM AND CRT DISPLAY; USES PAKS INSTEAD OF SOFTWARE UPGRADES
SUNRISE ELECTRONICS INC	Z-1000B	NO	NO	EPROM	$4995	
SYSTEM-GENERAL INC	SGUP-85	YES	NO	PC DISK DOWNLOAD BY RS-232C	$3450	CAN OPERATE WITHOUT PC EXCEPT DURING UPDATES
VARIX CORP	SP0300	NO	YES	DISK	$4600	
	GP1140LM	NO	YES	DISK	$5600	GANG-PROGRAMS EIGHT ICs

NOTES:
1. EXCEPT AS NOTED, UNITS THAT ARE NOT PC BASED CAN OPERATE IN STAND-ALONE MODE OR CAN USE A TERMINAL (OR A PC ACTING AS ONE).
2. PRICES INDICATED ARE FOR UNITS CONFIGURED AS UNIVERSAL PROGRAMMERS.
3. REQUIRES A COMPUTER, BUT WORKS WITH TYPES THAT ARE NOT IBM PC COMPATIBLE AS WELL AS ONES THAT ARE.

RS-232C port that permits you to connect them to a terminal (or a PC acting as a dumb terminal) if you want one, and they usually provide a second port that lets you download programming data. Some programmers have no local intelligence, however; they rely entirely on a PC for their smarts. These programmers interface with the PC via a parallel port or a proprietary I/O card; an RS-232C port isn't fast enough.

Device libraries expand in different ways

One difference between stand-alone and PC-based programmers is that units with local intelligence usually require firmware upgrades to augment their device libraries, whereas programmers that rely on a PC utilize software upgrades. Both methods have their advantages. For example, if the controlling PC is



Rugged universal programmer that includes a pair of 3½-in. floppy-disk drives *(Data I/O Corp)*

equipped with a hard disk, software upgrades are more convenient than firmware ones: You copy the database file from the distribution diskette onto the hard disk, and you're done—there are no PROMs to replace. On the other hand, if the PC has no hard disk, you have to make sure you don't lose the database diskette. Once you've installed new firmware, though, there's little chance you'll lose it.

To obviate PROM replacement, some intelligent programmers do incorporate floppy-disk drives. Programmers with local intelligence also include RAM to store the data that they will write into the devices they're programming. To increase the maximum capacity of the ROMs or PROMs such programmers can handle, you



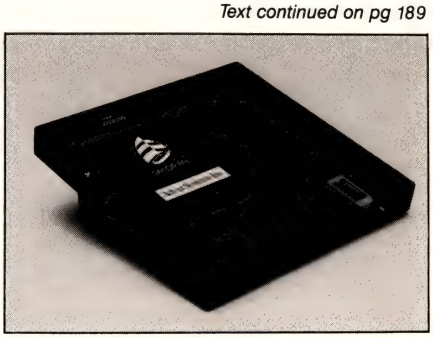
Economical, stand-alone, universal programmer that can gang-program most PROMs *(Bytek Corp)*

must usually increase RAM capacity. PC-based programmers, on the other hand, generally require no such RAM upgrades, because they use the PC's memory; some of them can even use the computer's disk drives as virtual memory.

Another architectural difference among programmers involves the use of what some manufacturers call "personality modules" to adapt the programmer to new device families. Most programmers that don't use personality modules incorporate identical drivers and measurement units for all device pins. This pin-driver approach is very flexible, but it can be costly. Suppliers of pin-driver-based programmers suggest that if you expect to use a wide range of devices over the life of a programmer, the pin-driver architecture will pay for itself by enabling you to avoid purchasing additional hardware.

On the other hand, programmers that use personality modules have an obvious advantage over many of those that don't—they can handle new package types without using socket adapters. A socket adapter plugs

Text continued on pg 189



PC-based universal programmer that employs no personality modules and uses software updates *(Advin Systems Inc)*

In some applications, when the annual part usage passes 10,000 units, it's less expensive to program the devices in circuit than to gang-program them.

In-circuit programming resolves vexing dilemmas

Unless you're working in military electronics, you may not even have thought of soldering programmable devices onto your pc boards and programming them *after* you've loaded the boards. In-circuit programming, as the technique is called, is aimed at resolving problems in production and field service. Many applications for in-circuit programming lie outside of military electronics. As a design engineer working on prototypes, you can probably get along quite well without an in-circuit programmer, because you can mount programmable devices in sockets. However, if your production or field-service people want to use in-circuit programming to write data into the devices on your boards, you have to understand the technique and follow some fairly straightforward design rules.

The case for in-circuit programming is a strong one. In airborne electronics packages, you can't use sockets, because their reliability in severe environments (especially high-vibration ones) is inadequate. But suppose that your circuit board incorporates EPROMs that contain firmware that's subject to frequent revisions. Further suppose that the board is densely packed—with fine line widths and many layers. If you unsolder the programmable devices to upgrade the firmware, you risk damage not only to the devices but to the board. Furthermore, the sockets of a conventional programmer won't make contact reliably with the leads of the unsoldered devices. Enter the in-circuit programmer. It avoids the problem entirely by making contact with the devices through the board they're mounted on.

Device-programming logistics

Suppose your company makes expensive capital equipment for commercial applications—some examples are supercomputers and multimillion-dollar automatic-test systems. A single pc board in such a system can sell for more than $10,000. Because of the relatively low production volumes of these boards, designers often submit engineering change orders after only a small number of boards have been produced. The frequent change orders mean that the population of boards in a given revision can be very small. Sometimes, system software revisions must track hardware revisions. If, when you power up the system, the software can determine the revision level of the boards and configure itself accordingly, the problem becomes manageable.

What you need to make this scheme work is a PROM on each board that stores the board's revision history. In addition to providing the system with configuration information, the



Portable in-circuit programmer with sockets for programming off-board devices *(Sunrise Electronics Inc)*

PROMs can store calibration coefficients for analog circuits and can record data that enables you to correlate failures with rework history. Each time you update the hardware, you record information in a previously blank location in the PROM. You don't want the PROM to be erasable, because erasing it would destroy the historical data.

Suppose you attempt to use socketed PROMs in this system. The chances are slim that a technician repairing three or four boards returned from the field will get each of the PROMs back on the exact board from which he removed it. (For that matter, it's possible that the technician might reverse at least one of the PROMs in its socket and blow it up when he applies power to the board.) Unless you're an inveterate optimist, you realize that using socketed PROMs in this application can cause more problems than it will ever solve. This application, too, calls for in-circuit programming.

Manufacturers of in-circuit programmers even see their instruments invading the manufacture of high-volume commercial electronic assemblies. Allan Carey, vice president of sales and marketing at Sunrise Electronics, a company that has been supplying in-circuit-programming systems since 1980, says that in some applications, when the annual IC usage passes 10,000 units, it becomes less expensive to program the devices in circuit than to program them with a gang programmer. For one thing, the saving in socket cost offsets the higher initial cost of the programmer. Because most boards that Sunrise considers to be candidates for in-circuit programming contain several programmable devices, the economic crossover point occurs at board volumes lower than 10,000 units.

Only a few companies make in-circuit programmers. (**Table A** lists representative products.) The short list of suppliers reflects the relatively small size of the market. In-circuit programmers are more expensive than programmers for unmounted devices, but as with universal programmers, their price range is very broad—they begin at under $10,000, but in some cases exceed $100,000. (The higher figure is the price of a unit that can perform gang programming of multiple boards.) Within the past 18 months, vendors have begun to introduce portable in-circuit programmers that can reprogram board-mounted devices in the field. Such programmers can, for example, reprogram the firmware of an avionics package during routine maintenance of the aircraft.

Usually, you use an in-circuit programmer to program CMOS or NMOS PROMs or EPROMs,

Box continued on pg 188

TABLE A—REPRESENTATIVE IN-CIRCUIT PROGRAMMERS

VENDOR	MODEL	DESCRIPTION	US BASE PRICE[1]
DATA I/O	156A	IN-CIRCUIT-PROGRAMMING SYSTEM FOR HIGH-VOLUME PRODUCTION HANDLES EIGHT TO 32 BOARDS	$57,865
	PORTABLE IN-CIRCUIT PROGRAMMER	FOR BENCHTOP OR FIELD; PROGRAMS ONE TO FOUR BOARDS	$12,000
LOGICAL DEVICES	UNIPRO-ICP	STAND-ALONE IN-CIRCUIT PROGRAMMER PRIMARILY FOR EPROMs AND EEPROMs	$7995
OLIVER ADVANCED ENGINEERING	OMNI IPS	PORTABLE IN-CIRCUIT PROGRAMMER THAT USES SOFTWARE-CONFIGURED PIN DRIVERS	$15,000
SHERMAN PIRKLE INC	8806	PROGRAMS A WIDE RANGE OF 8- AND 16-BIT-WIDE EPROMs AND EEPROMs IN CIRCUIT	$5000
STAG MICROSYSTEMS	Zm2900	CUSTOM BOARD-LEVE PROGRAMMER BASED ON PPZ MAINFRAME AND CUSTOM INTERFACE	FACTORY QUOTE ONLY
SUNRISE ELECTRONICS	T-5000	PORTABLE IN-CIRCUIT PROGRAMMER THAT INTEGRATES IBM PC/AT COMPATIBLE COMPUTER	$18,500
	T-8000	IN-CIRCUIT PROGRAMMER FOR FACTORY USE. CAN PROGRAM AS MANY AS 48 PC BOARDS AT ONCE	$45,000

NOTES:
1. BECAUSE ALL IN-CIRCUIT PROGRAMMERS INVOLVE CUSTOM ENGINEERING, BASE PRICES, WHERE INDICATED, ARE APPROXIMATE.

Programmers that use personality modules have one advantage over many that don't—they can handle new package types without using socket adapters.

though some instruments can program bipolar devices and PLDs. Before choosing an IC for in-circuit programming, you should carefully consider its programming yields. If appreciable numbers of devices fail to be programmed in circuit, your pc-board rework costs will escalate. Fuse-programmable devices, such as bipolar PROMs, are poor candidates because of their relatively low programming yields.

Custom designs are the norm

In-circuit-programmer vendors usually create custom-engineered fixtures for their clients' boards. When designing a board for in-circuit programming, you must provide access for all of the signals needed to program your devices. Programmer vendors prefer that you make these signals appear on edge connectors. Though the fixtures for some boards employ spring-loaded pogo pins in a bed-of-nails configuration, these fixtures usually succeed only where programming currents are low.

Vendors will discourage you from accessing the programmable devices through DIP clips: They've used the technique on occasion, and it's troublesome. If your design's edge-connector pins are limited, consider using a separate connector just for programming, but remember that its placement may be critical.

In designing the fixture for your board, one of the vendor's primary objectives is to minimize cable length. Transmission-line effects in even relatively short cables make it difficult to control the shape of programming-waveform edges. Poorly controlled waveforms can lead to unacceptable programming yields. Ground bounce is another bugaboo of in-circuit programming: When current changes in the ground lead, even with greater-than-normal care in device decoupling, the rate of change in current with respect to time (di/dt) multiplied by the ground lead's inductance can crèate destructive voltage spikes.

If your devices' programming-voltage (V_{PP}) pin is also used for another function, be sure that the high programming voltage will not damage the gates that drive the V_{PP} pin during the normal operation of your board. Open-collector gates will usually survive; standard TTL outputs usually won't. During programming, be sure that you can set the outputs of any drivers on your board that drive the programmable devices' address lines into a high-impedance state. To safeguard the other logic on your board, it's good practice to insert a diode that becomes reverse-biased during programming in series with the pullup resistors of the open-collector gates that drive V_{PP}. And, of course, be sure that the programmer can *separately* access the V_{PP} line of each device.

Other guidelines for in-circuit-programmable board designs sound very much like design-for-testability rules. For example, you need to be sure that during programming you can gate any free-running oscillators into an off state.

And if you lavish such care on your board, you'll certainly want to consider how well your programmer's control software lets you isolate device failures. The instruments usually perform set programming of the board-mounted devices. After programming, the programmer must not only determine whether any devices failed to program correctly, it must also clearly indicate to a repair technician which ones he must replace. This requirement has some impact on the format of the files that store the programming data—in addition to the information found in many industry-standard structures, the files must contain device identity.

Although the rules presented here are not complex, if you have any questions about whether you're implementing them correctly, help is available. All of the in-circuit programmer vendors stand ready to review your schematics to make sure that their programmers can handle your boards.

Reference

1. *Introduction to In-Circuit Programming: A Basic Guide for Production Managers and Design Engineers*, Data I/O Corp, Redmond, WA, 1988.



Universal programmer contained largely on a PC-bus I/O card *(Adams-Macdonald Enterprises Inc)*

into the socket of a programmer designed to handle one type of package and lets you insert a different type. Socket adapters are rugged enough for most engineering-lab applications; in heavy production use, however, you'd prefer something sturdier.

To overcome the ruggedness problem, some vendors employ package adapters. Package adapters resemble personality modules in that they plug into connectors within the programmer rather than into device sockets; however, their function is basically that of a socket adapter. If you have a programmer that uses personality modules and doesn't use package adapters, you can use a socket adapter in combination with a personality module. But you should probably contact the programmer vendor instead; most of them can supply personality modules that directly accommodate the package you're using.

Pin-driver architecture offers flexibility

According to David Motarjemi, president of Logical Devices Inc (LDI), the beauty of pin-driver-based programmers that depend on a personal computer for all of their intelligence is the ease with which such units can accommodate new devices. LDI's Allpro series typifies these programmers. It handles new devices entirely with software updates; it uses no personality modules or other device-specific hardware. Despite the flexibility of the pin-driver design approach, it isn't always easy to increase the maximum pin count of the devices that a pin-driver-based programmer can handle. With LDI's Allpro units, you must make an initial choice between 28- and 40-pin models.

Most universal programmers (but by no means all) target users in development labs. These programmers don't include gang-programming capabilities. Many also lack set-programming capability. "Gang programming" is the term applied to programming a number of devices simultaneously with identical data; "set programming" refers to programming several devices simultaneously with different data. For example, you might program four byte-wide PROMs as a set containing the firmware for a 32-bit μP. Or you might use a gang programmer to simultaneously make 16 copies of one of the four PROMs in the set.

Algorithm development is not for amateurs

The task of developing programming algorithms for the torrent of new devices that IC vendors are introducing presents a formidable challenge to programmer vendors. What can appear to be an easy way around this problem is to let customers do the algorithm development. A number of vendors see this approach as excessively risky, however. LDI's Motarjemi states that although his company could easily offer a software package that would permit users to create programming algorithms for new devices, he refuses to allow it. "It would be a big profit item for us . . . for a little



Programmer whose rugged package adapters resemble personality modules but function as socket adapters *(Logical Devices Inc)*

To create programming algorithms, you have to work with device specs that are often ambiguous and frequently contain errors.

while," he says, "but ultimately it would backfire."

The problem is that to create programming algorithms, you have to work with device specs that are often ambiguous and frequently contain errors. Yet vendors must make sure that their programmers will operate reliably with all of the parts they claim to support. "Programmer vendors that let their customers develop programming algorithms are courting disaster," Motarjemi asserts. "What happens when the word gets out that their programmer blows up a particular part? Nobody asks whether a customer developed the algorithm, or if the device manufacturer approved it."

The idea that your relationships with suppliers are critical is certainly not unique to device programmers. But programmers provide a classic example of a three-cornered vendor-customer relationship. Although some device manufacturers sell programmers, you're likely to purchase a programmer from a company that doesn't make ICs. Particularly in the case of universal programmers, which program a wide variety of devices, the very factors that motivated you to select a universal instrument will probably steer you toward a vendor that doesn't make ICs. In this case, not only are your relationships with the programmer vendor and the IC vendor important, but timely completion of your project may hinge on those vendors' relationship with each other.

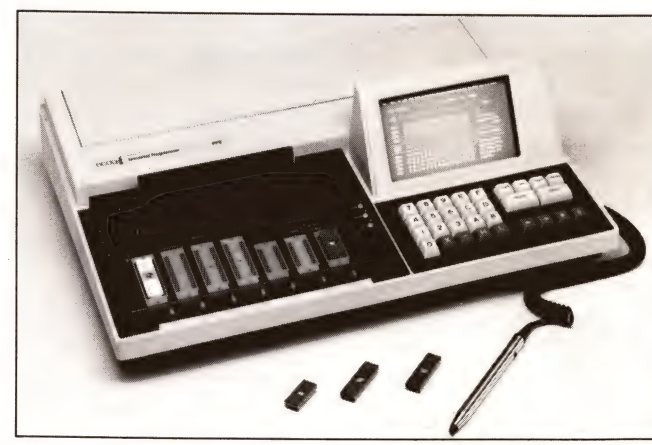
Timely device support demands persistence

The larger programmer manufacturers insist upon getting the device vendors' blessing before releasing programming algorithms to their customers. The process of obtaining approvals can be time consuming. Device vendors naturally place the highest priority on approving the algorithms submitted by the programmer vendors whose customer base is largest. This situation tends to perpetuate the dominance of a few programmer suppliers. Nevertheless, by maintaining a high level of persistence, many smaller programmer companies are successful in obtaining timely approval of their algorithms. These companies' long lists of supported devices attest to the energy the firms devote to their relationships with IC vendors.

As PLDs have increased in popularity, the number of vendors supplying programmable devices has increased, and so has the number of products each vendor introduces annually. Consequently, programmer vendors must work ever more feverishly to keep pace. One programmer company, Inlab, recently announced a program, called Asset, that attempts to address this problem. Under Asset, Inlab will provide assistance to an IC vendor in characterizing devices and developing programming algorithms. The assistance includes the use of some of Inlab's proprietary in-house development tools. The payoff to the IC house is quicker programmer support for new products. Robert Holzner, Inlab's vice president for corporate development, claims that initial response to Asset from semiconductor manufacturers has been very encouraging.

Process changes affect programming algorithms

Even if the programming algorithms work flawlessly at the time an IC is introduced, IC process changes can produce a number of problems for programmer users as well as for vendors. Frequently, as a newly introduced IC moves from pilot to high-volume production, the need to optimize yields will force the IC vendor to make subtle process changes. Such changes frequently necessitate adjustments to the programming algorithms. Similar situations can even crop up later in the life cycle



Programmer with integral CRT and light pen *(Stag Microsystems Inc)*

of an IC. Such changes can force a programmer vendor to remove the device temporarily from its list of supported parts.

The length of these lists indicates another area that's at least as important as device-design stability—the device-interchangeability problems that can ambush unsuspecting engineers. When you select a programmable device and want to ensure that you'll have a second source, be sure to check your programmer

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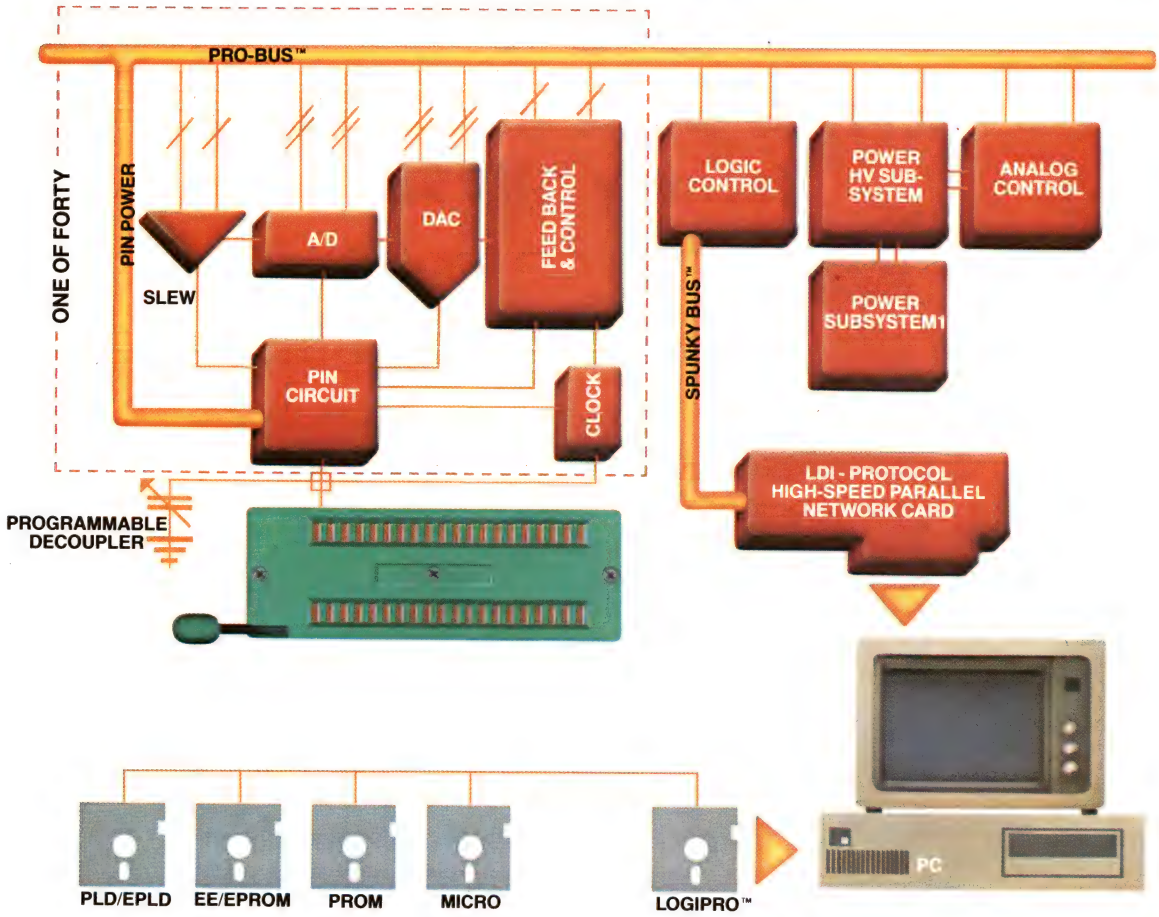
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CIRCLE NO 123

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CIRCLE NO 124

The only way to be certain that a programmer supports a specific device is to check the programmer vendor's latest list of supported parts.

vendor's *latest* list of supported devices to make sure your programmer can handle the alternate part. Just because two devices have similar part numbers, and just because they're fully interchangeable in your circuit once they're programmed, don't assume that your programmer can handle them interchangeably. In more than one case, the algorithms that program one vendor's devices damage a competitor's "interchangeable" parts.

To be able to guarantee that, over the next decade, the introduction of new programmable devices will not render a programmer obsolete, the manufacturer would have to employ not only a first-rate design staff, but also a high-quality crystal ball. So universal programmers do not offer a guarantee against obsolescence. What they do offer is good value, impressive capability, and a high probability that for years to come they can meet the needs of designers (and in some cases, the needs of production groups) at a reasonable cost over the instruments' lifetime. **EDN**

Article Interest Quotient (Circle One)
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For more information . . .

For more information on the universal programmers described in this article, contact the following manufacturers directly, circle the appropriate numbers on the Information Retrieval Service card, or use EDN's Express Request service.

Adams-Macdonald Enterprises Inc
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Monterey, CA 93940
(408) 373-3607
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Circle No 410

Advin Systems Inc
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Sunnyvale, CA 94086
(408) 984-8600
TWX 510-600-5624
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Bytek Corp
1021 S Rogers Cir
Boca Raton, FL 33487
(407) 994-3520
TLX 4998369
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Cypress Semiconductor
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San Jose, CA 95134
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Data I/O Corp
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TLX 152167
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Circle No 423

Stag Microsystems Inc
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Santa Clara, CA 95054
(408) 988-1118
TWX 910-339-9607
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Sunrise Electronics
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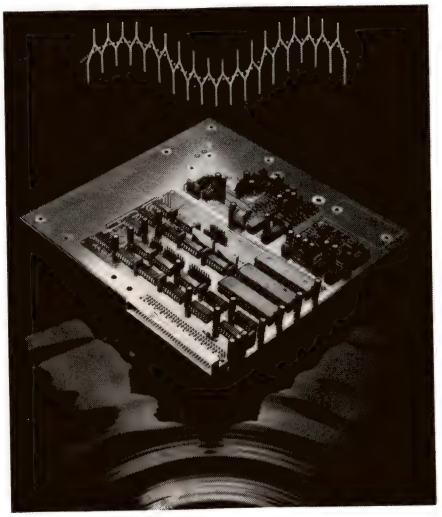
BYTEK Corporation Instrument Systems Division, 1021 S. Rogers Circle, Boca Raton, Florida 33487

CIRCLE NO 125

Ripple-and-noise test module uses voltage-comparison technique

This ripple-and-noise test module, intended for use in testing switching-regulated power supplies, plugs into the vendor's 6500 modular automatic power-supply test system. The module's operation depends on voltage-level and duty-factor sensing rather than conventional noise-measurement techniques.

The module makes reproducible ripple-and-noise measurements without using filters and rms-to-dc converters. Instead, the 30-MHz device employs an unusual A/D-conversion technique that takes advantage of the fact that the switching-spike component of a power supply's ripple-and-noise waveform normally has a low duty factor. The module adjusts a voltage



comparator's reference input signal until its value is lower than that of the ripple and noise under examination for a programmable, and normally small, fraction of the total time. By adjusting the fraction until the reference-signal value begins to increase rapidly, you can determine the noise-pulse duty factor. The module then reports the value of the reference signal—a value proportional to the ripple component of the ripple and noise. A 3-channel module costs $3800; a 7-channel module sells for $4500. Prices for the 6500 system range from $30,000 to $500,000; most configurations cost less than $100,000.

Intepro Systems Inc, 450 Bedford St, Lexington, MA 02173. Phone (617) 863-9500. TWX 510-601-8053.

Circle No 430

Matrix-switching system connects 2880 cross points

The Model 707 matrix-switching system for electronic-device and -circuit testing is housed in a 6-slot mainframe that plugs into any IEEE-488 automatic-test equipment (ATE) system. It can connect as many as 2880 cross points on a breadboard prototype of an IC or on a pc board. It also provides a light-pen user interface. You can connect as many as five of the 707 mainframes, each of which can switch configurations of as many as eight 72-pin paths.

The cards available for the mainframe slots include a general-purpose matrix for microvolt to 200V signal levels, a coaxial matrix for low-noise shielded interconnections, a semiconductor matrix card that automates both current-voltage (IV) and capacitance-voltage (CV) tests through two high-isolation current paths, and a universal adapter card for prototyping or troubleshooting. Because the unit controls all those switches through one master device, you can set up as many as 200 matrices/sec while monopolizing only one IEEE-488 address. The unit's nonvolatile matrix memory retains as many as 100 of those matrix settings for fast-triggered relay sequences or rapid recall.

The 707 has a front-panel LED matrix display that represents the cross points on the circuit under test. It also has a continuous switch-status display, so you can determine the status of a relay by glancing at the panel. The light-pen user interface lets you change the state of a relay simply by touching the front panel with the pen. This method reduces both the setup time and the potential for errors. The Model 707 costs $3500. The light-pen interface sells for $250, and prices for the plug-in cards range from $800 for the universal adapter card to $4900 for the semiconductor matrix card.

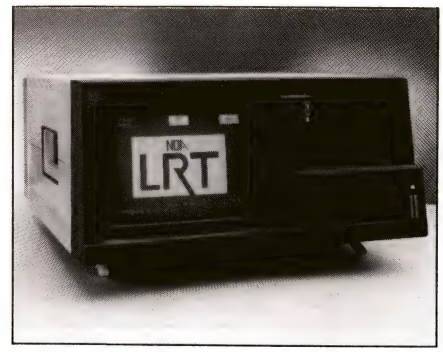
Keithley Instruments Inc, 28775 Aurora Rd, Cleveland, OH 44139. Phone (216) 248-0400.

Circle No 431

LAN analyzer diagnoses Ethernet faults to prevent system failures

By using the NQA (network-quality analyzer) to monitor an Ethernet (IEEE-802.3) LAN, you can pinpoint and repair network faults before they can render the network inoperative. The analyzer examines both the physical (layer 1) and the data-link (layer 2) characteristics of the LAN. Unlike other physical-layer testers, the NQA can perform in-service time-domain reflectometry (TDR) tests to locate major cable and transceiver defects. The analyzer's layer 2 protocol-analysis functions let you examine network utilization.

Without disturbing normal traffic on the LAN, the analyzer measures five coaxial-cable signal parameters for each transmitted Ethernet packet (jitter, dc component, ac component, fall time, and bit rate) and also measures the network's bias voltage. By examining the framing information to determine each packet's source, the analyzer can correlate most of these cable measurements with particular network nodes.



You can perform in-service TDR measurements via a special cable implant. By examining the TDR trace, you can locate incorrectly installed transceivers and a variety of cable faults, including short or open circuits, to within ±1.2m. The range of the TDR measurement is greater than 500m on both sides of the implant unit. You can also control and interrogate the NQA analyzer via the network. The NQA costs around $25,000.

Logic Replacement Technology Ltd, Arkwright Rd, Reading, Berks RG2 0LU, UK. Phone (0734) 311055. TLX 847395.

Circle No 436

Digital storage scope offers four channels and 100-MHz bandwidth for less than $3500

Priced at $3465, the HP 54501A 4-channel, 100-MHz digital storage oscilloscope (DSO) provides time and voltage cursors for user-selectable measurements. Its digital timebase permits timing measurements that are more accurate than those typical of analog scopes. The DSO's dual-timebase window allows you to view pretrigger events.

Besides offering standard edge- and TV-triggering modes, the 22-lb 54501A includes a custom IC that gives you a variety of special triggering functions similar to those of logic analyzers. Pattern triggering, for example, lets you trigger from the four input channels, selecting a high, low, or "don't-care" pattern. To trigger on synchronous events, you can use any three channels to select high, low, or don't-care states, and you can use the fourth channel as the clock. You can select triggering to occur on the rising or falling edge of the clock either when the pattern is present or when it's not. You can delay triggering according to the number of events (to as many as 16 million) or according to time increments ranging from 30 nsec to 160 msec.

You can save and recall waveforms and oscilloscope setups. The 54501A has four nonvolatile waveform memories and two volatile pixel memories. It also has two 10M-sample/sec, 8-bit ADCs. Although it's intended primarily for repetitive-waveform applications, you can use the DSO to capture single-event waveforms to about 1 MHz.

Hewlett-Packard Co, 19310 Pruneridge Ave, Cupertino, CA 95014. Phone local office.

Circle No 433

KEITHLEY ON SWITCHING:

IT'S IN THE CARDS



Our line of 18 signal switching cards is the widest variety anywhere, so you can configure a system to match your signal types without sacrificing system performance.

SIGNAL INTEGRITY

To get the most from your test system, you must make sure your signals are switched without attenuation, distortion or alteration by the switching and interconnect. Since Keithley has more switching cards than anyone, you can be assured of signal integrity, no matter what the test. Choose from:

Matrix	Most flexible
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Temperature	Thermocouple cards with $<1\mu V$ offset and built-in reference
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Keithley switching further simplifies system integration with digital I/O, triggers in/out, relay setup memory, inspect mode for determining relay configuration, and more.

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Keithley Instruments Inc., 28775 Aurora Road, Cleveland, Ohio, 44139. (216) 248-0400.

Call or write the Information Center for more on Programmable Switches, Sources, and Measurement Instrumentation. Then find out how to receive your free copy of Keithley's new Switching Handbook with useful information and practical guidelines on getting maximum performance from your test system.

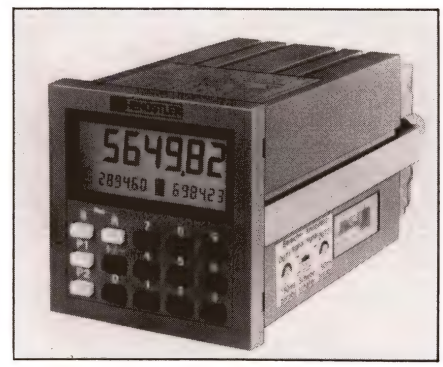
SOURCE • MEASURE • CONNECT

KEITHLEY

CIRCLE NO 126

Panel counter offers two count thresholds and programmable operating modes

The Dino panel counter can perform a variety of simple control functions without additional circuitry. Its DIN-standard, 72-mm square front panel houses a 7-digit LCD that indicates the current count, two 6-digit LCDs that indicate preset counts, and a keyboard through which you can enter the preset count values. To prevent unauthorized changes, you can totally or partially disable the keyboard.



When the current count coincides with either of the preset counts, a corresponding control output is activated. DIP-switch settings let you set these outputs to bistable (above/below threshold) mode, or let you set one of them to monostable mode. You can program the main counter to reset when the highest preset count is reached. Depending on the model, these outputs are either changeover relay contacts or short-circuit protected transistor outputs. Additional outputs indicate the zero-count condition and the count direction.

You can configure the counter inputs for continuous up or down counting or for difference counting, or you can configure them as a 1-, 2-, or 4-phase phase discriminator. The input-frequency limits are 5 kHz and 30 Hz, respectively, for electronically and mechanically generated pulses. The Dino counter operates from a 10 to 30V dc supply or a 100 to 270V ac supply. Under DM 500.

Hengstler GmbH, Postfach 100, 7209 Aldingen 1, West Germany. Phone (07424) 891. TLX 760422.

Circle No 439

Hecon Corp, 15 Meridian Rd, Eatontown, NJ 07724. Phone (201) 542-9200. TLX 132457.

Circle No 440

Menu-driven DMM features bar graph

The Model 560 DMM has an abundance of features that you access with a menu-driven interface. The basic unit is a 2.5-lb, Z80-based DMM that stores 2150 readings in nonvolatile, battery-backed RAM and costs $2195. The readings have 5-digit resolution (99,999 counts) and a minus sign.

The DMM's 52-segment bar graph provides real-time voltage and autorange representations that are independent of the decibels or hertz you're measuring, so you can take a reading and monitor the test point in real time simultaneously.

In addition to the standard ohms range, the meter has a high-power ohms range that's useful in testing semiconductor junctions. It also features frequency counting, true RMS, fusing on both current inputs, diode testing, high-speed autoranging, digital filtering, a TC reference, and digital calibration. A zero function eliminates lead resistance in your readings. The unit also provides a peak hold that's completely independent of A/D converters, so it can catch small line transients.

The menu interface lets you specify the range for stored readings; you can also set the storage rate and the decibel reference. Two interface options are available: a Centronics-compatible parallel port or an RS-232C serial port. Each is fully isolated, has its own power supply, and costs $200. There are no field upgrades, so you have to send the unit back to the company for an interface installation. Or you can simply order a 560 with either port already installed for $2395.

Simpson Electric Co, 853 Dundee Ave, Elgin, IL 60120. Phone (312) 697-2260. TLX 722416.

Circle No 432



128 TIMES THE MEMORY DEPTH AND LIGHT-YEARS AHEAD OF THE COMPETITION.

Only the Tek DAS9200 with its new 92A90D acquisition module gives you a memory depth of 128K bits-per-channel—128 times the depth provided by the most popular alternatives. No wonder it alone lets you see so much, so easily, for so many complex applications.

■ **Better-than-ever multiprocessor support.** Now get the depth of overlapping data you need for debugging designs involving processors like the 68030, 88100, and 80386—up to six at a time.

■ **Timestamping without penalty.** For correlating multiprocessor interactions, the 92A90D lets you place a 44-bit timestamp value on every transaction stored—at no cost to your 128K memory depth.

■ **Selective data suppression.** To help you analyze 131,072 90-channel bus cycles in one acquisition, Tek provides high-resolution color, highlighting, address symbols, and your choice of tailorable display formats. You can choose an overview of subroutine activity or program branches, a full assembly listing, or a format that shows every bus transaction in order.



To find out more about the Tek DAS9200 Digital Analysis System, the most powerful problem-solver around, contact your Tek representative, or call **1-800-245-2036.** In Oregon, 231-1220.

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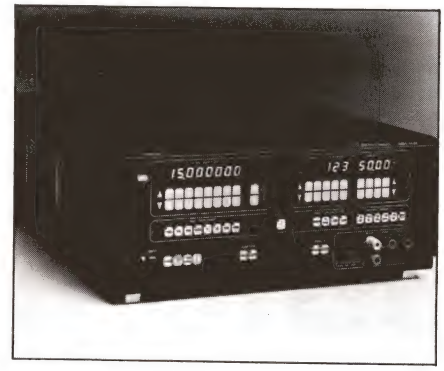
Circle 127 for literature
Circle 128 for sales contact

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Fast-responding ac-voltage standard offers 32-ppm amplitude uncertainty

The Model 6400A delivers ac voltages from 1 nV to 1000V at frequencies from 10 Hz to 1 MHz. These settings include an amplitude uncertainty of 475 ppm at 1 MHz, or only 32 ppm over the 40-Hz to 20-kHz range. Resolution is 1 ppm throughout each of the seven amplitude ranges, whose full-scale levels range from 1 mV to 1000V in increments of one decade. The ac output settles to within 100 ppm in less than 2 sec between 40 Hz and 1 MHz. Moreover, you can calibrate the 6400A in about one hour.

The instrument's 7.5×10^7V-Hz rating means that it can deliver 75V



at 1 MHz or 1000V at 75 kHz. Its output-current capability is 50 mA for the 1, 10, and 100V ranges and 60 mA on the 1000V range from 10 Hz to 1 MHz. The 6400A's total harmonic distortion and noise is 400 ppm max from 10 Hz to 20 kHz. Its output impedance is 1.5Ω on the lower three ranges, and it offers electronic protection against output overloads and short circuits. The basic model (200V maximum amplitude; 7.5×10^7V-Hz) costs $12,000. Option 75 extends the amplitude to 1 kV from 10 Hz to 10 kHz for $3950. Option 76 provides 1-kV operation from 10 Hz to 100 kHz for $7400.

Ballantine Laboratories Inc, Box 97, Boonton, NJ 07005. Phone (201) 335-0900.

Circle No 434

Low-cost timing analyzer simplifies trigger setup

Targeting hardware engineers who need a low-cost, high-performance timing analyzer, the LAL logic analyzer provides sixteen 100-MHz, variable-threshold input channels or eight 200-MHz channels. To maximize trace length, the analyzer employs transitional timing, and it incorporates a glitch-capture facility that can capture glitches as short as 3 nsec.

The analyzer's internal clock resolution ranges between 5 nsec and 4 μsec, and you can add an optional clock probe with three clock qualifiers to externally clock the analyzer at frequencies as high as 100 MHz. To simplify instrument setup, the analyzer lets you select data-format and trigger functions from a menu.



You can select from 13 predefined trigger functions, including edge, glitch, and window triggering. You need only specify the trigger word and timing information to complete the trigger setup. The instrument provides an on-screen graphical display of the trigger conditions in the form of a timing diagram.

The analyzer's 7-in. CRT can display as many as 16 channels of timing, or it can display the data in list form. You can also download the screen to a separate monitor via an RS-232C interface. The analyzer costs approximately DM 12,000.

Rohde & Schwarz GmbH, Mühldorfstrasse 15, 8000 Munich 80, West Germany. Phone (089) 41290. TLX 523703.

Circle No 437

Rohde & Schwarz Inc, 4425 Nicole Dr, Lanham, MD 20706. Phone (301) 459-8800. TWX 510-223-0414.

Circle No 438

0 to 60 in 5 seconds



with new UniLab Microprocessor Development Tools

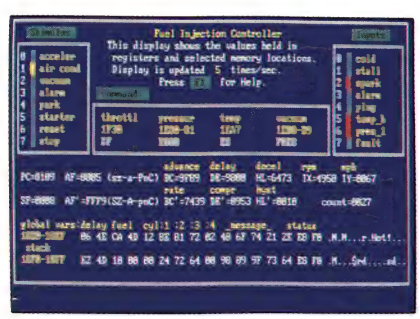
■ 64Kbytes from hard disk to emulation memory in 5 seconds. That's moving. But today you've got to be fast just to stay in the race for better microprocessor designs.

■ The secret is a new, high-speed parallel interface: the Orion bus. Which zips data between your PC/AT and the 8620 analyzer-emulator, breaking the RS-232 bottleneck.

■ The 8620 with O-bus gives you complete program diagnosis — and solutions — in real time. For more than 150 different microprocessors. Using **the same command set** environment.

■ A generous 2730 trace-cycle buffer with selective filtering lets you cut through the clutter and display just the traces you wish. And you get 1μsec resolution in program time measurement. Plus continuous InSight monitoring of your program's key functions as they are performed.





InSight Display. InSight blends analyzer-emulator techniques to give you continuous, real time monitoring of key processor functions. And still services user interrupts. It displays changing register contents, I/O lines, ports, user-defined memory windows. With your own labels.

■ On top of that, you get UniLab's trademark ability to debug by symptom, not just by breakpoint and single step. And, to help you complete the job on time, on the spot, a stimulus generator and EPROM programmer are included.

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Analyzer Triggers. Commonly used triggers can be selected quickly from a list of standard and user-defined triggers.

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702 Marshall St., Redwood City, CA 94063
TLX 530942 FAX 415/361-8970
Computer Integrated Instrumentation

CIRCLE NO 129

Digital storage scope's graphic printer provides hard copy of screen display

The SE571 digital storage oscilloscope (DS0) accepts two analog inputs and eight digital control signals. The scope's thermal printer can produce a hard copy of the screen display on command. Printing takes about 10 sec, and the copy includes the date, the trigger time, and the measurement parameters. An optional IEEE-488 interface (optional) lets a computer control the scope in an automated data-acquisition system or allows the scope to download data to the computer for further analysis. Each analog channel's 25-MHz A/D converter provides a −3-dB channel bandwidth of 15 MHz. The time base ranges from



1 μsec/div to 500 sec/div in 1-2-5 sequences.

The screen displays signals as a computer screen does, using the raster-scan method. Although the display is drawn from stored digital data, the scope's rapid image processing allows time-varying signals to appear live, as they do on a conventional analog oscilloscope. As you position a reference and main cursor on the displayed waveform, the left side of the screen reads out signal frequency, the voltage at the cursor position, and the time and voltage differences between the main and reference cursors. Eight logic channels enable the SE571 to function as an 8-bit logic analyzer. SE571, $6900; with the IEEE-488 interface, $7500.

BBC-Metrawatt/Goerz, 2150 W 6th Ave, Broomfield, CO 80020. Phone (303) 469-5231; (800) 821-6327. TLX 4970869.

Circle No 435

To: Intel 80x86 compiler users— PC or VAX™

Subject: Reducing Debugging time and cost

Do you debug 8086-family software using emulators? Then please consider our high-level cross debugger, MicroSCOPE.™ It can save time by giving you full source-display in C, Pascal, PL/M, FORTRAN, and Ada with emulators from Intel,™ Tektronix, and others.

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MicroSCOPE debugs real-time target systems based on the 8086, 80186, and the 80286 in both real and protected mode. It works with compilers from Intel, First Systems, Softech and DDCI Ada, and with any others using Intel symbols.

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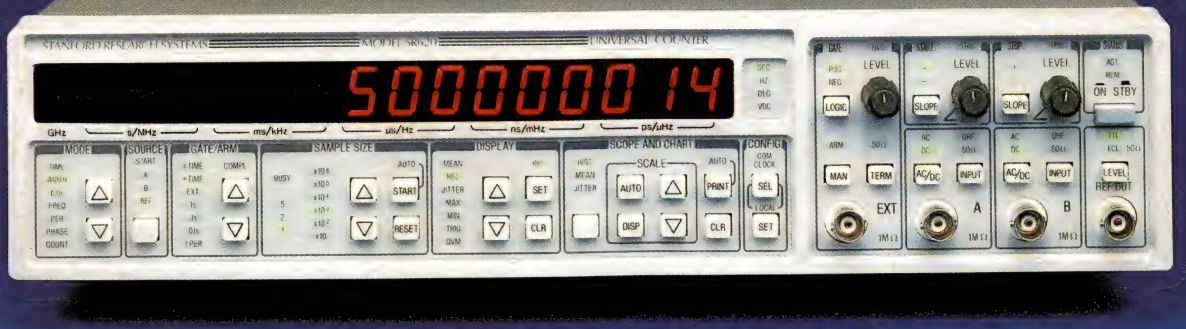
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FIRST SYSTEMS CORPORATION
2275 West Torrance Blvd.
Torrance, CA 90501
Telex: 298086 (FIRSYS)

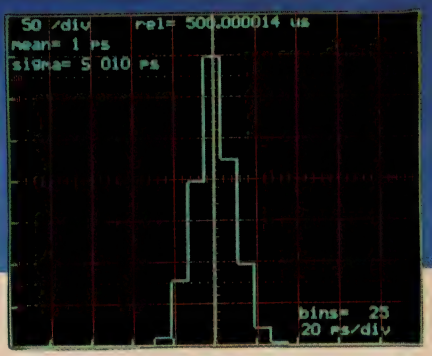
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CIRCLE NO 130

Time interval measurement. $3850.



4 ps single-shot resolution
1.3 GHz frequency response
Statistics, analysis, and graphics



The SR620 provides graphic display of histograms and strip charts on any X-Y oscilloscope. With Autoscale and Zoom, graphics can be easily scaled. Attach a dot matrix printer or an HP-GL plotter and obtain hardcopy of any graph.

Finally, high resolution time interval measurement at an affordable price. The SR620 Universal Time Interval Counter offers 4 ps single-shot LSD on time intervals, and 11 digits of frequency resolution in one second. With powerful arming, gating, and triggering modes, the SR620 can measure time interval, frequency, period, pulse width, and phase, as well as rise and fall times.

The SR620 has built-in statistical functions, including mean, min, max, standard deviation, and Allan variance for up to 1 million samples. Results may be displayed on the front panel, and graphed in histogram or strip chart form on an X-Y oscilloscope. Hardcopy is directly available on a plotter, printer, or chart recorder.

With both RS-232 and GPIB interfaces standard, the SR620 is also ideal for ATE applications.

Whatever your time or frequency measurement needs may be, the SR620 is the answer. For more information, call us at **(408) 744-9040.**

SR620	**$3850**
Single-shot resolution	4 ps
Time interval jitter	20 ps rms
Maximum time interval	1000 s
Maximum frequency	1.3 GHz
Frequency resolution	10^{-9} Hz
Phase resolution	0.001°
Statistics	Mean, Min, Max, Std. Dev, and Allan Var.
Sample size	1 to 10^6
Analyzer	Display on X-Y scope
Graphics	Histogram and Strip Chart
Hardcopy	Printer/Plotter
Interfaces	GPIB and RS-232
Oven Timebase (5×10^{-10}/day)	**$950**

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CIRCLE NO 131

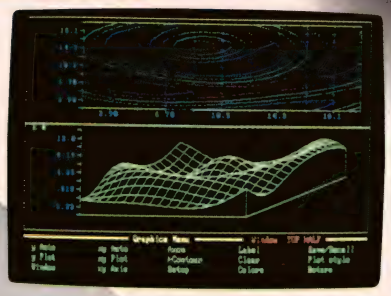
7.5 good reasons to try ASYSTANT GPIB.



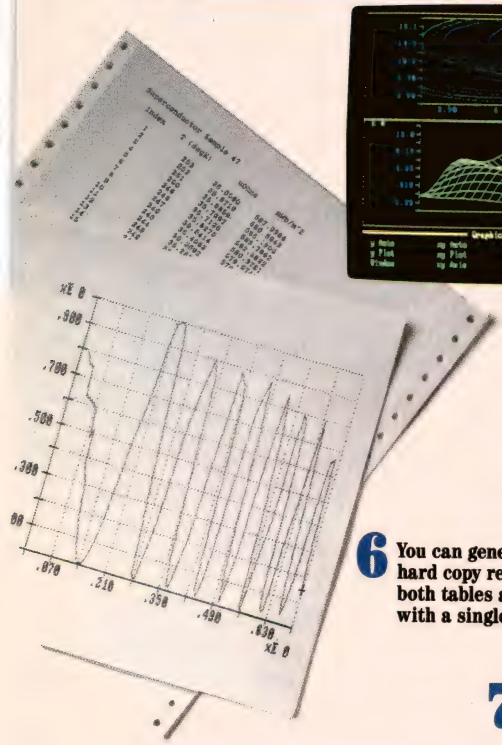


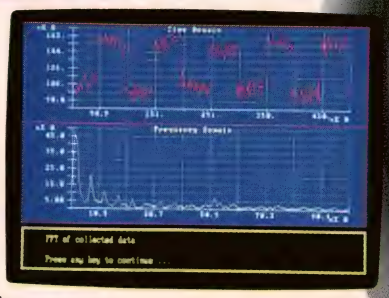
1 ASYSTANT GPIB Software hands you control of your IEEE-488 instruments.

2 No programming re... be up and running fro...



3 Now you can store, plot, reduce, analyze, compare, archive, characterize, and calculate your data.





4 ...ick from a menu ...o create automated routines that bring your data from source to solution—even when you're not there.

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7.5 **30-day money-back guarantee.**
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For the IBM PC, XT, AT, or 100% compatible computers and the IBM PS/2.

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- Capital Equipment PC<>488 Models 300 and 310, 4x488
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CIRCLE NO 132

BUS ANALYZER

The ABA 500 portable or rack-mountable bus analyzer is based on a 68000 μP clocked at 8 MHz. It includes 1M byte of RAM, a detachable keyboard, an electroluminescent display, and, optionally, a 20M-byte rigid disk, or a 5¼-in. floppy-disk drive. It can automatically test systems based on the MIL-STD-1553 bus, or units intended for connection to the bus, for compliance with the bus protocol.

It can also act as a bus controller, as a remote terminal on the bus, or as a monitor of all bus traffic. When used as a monitor, it provides extensive diagnostic displays; for off-line analysis, it can store bus-traffic records as long as 2.3M bytes. RS-232C, IEEE-488, and Centronics-parallel interfaces are standard, thus facilitating the unit's use in ATE systems. $22,950 for rack-mount version; $25,950 for portable version. Delivery, eight weeks ARO.

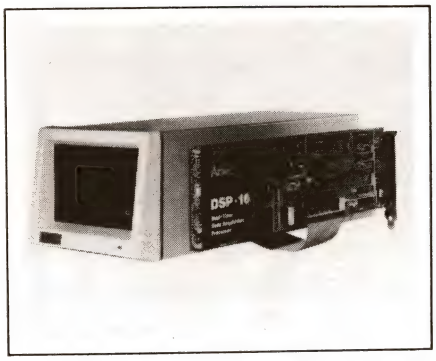


Interface Technology, 2100 E Alosta Ave, Glendora, CA 91740. Phone (818) 914-2741. TLX 494-5489.

Circle No 610

INTERFACE

The SDI signal-to-disk interface allows real-time acquisition, direct-to-disk recording, and processing of two channels of data at a 50-kHz rate. The unit consists of software



and a PC-bus-compatible board that contains signal-conditioning circuits, a 16-bit ADC, and a SCSI interface. Its onboard processor relieves the PC's μP of the need to control data flow to and from disk, making possible the high data-transfer rate. A special disk operating system, which coexists with MS-DOS, controls operations related to SCSI data-storage devices. You can obtain the interface system with either 50M- or 250M-byte internal or external SCSI-interfaced hard drives; the SCSI bus and the

Universal Logic Device Programmers

The Stag ZL30A provides:

- Extensive PLD, EPLD and GAL* programming support for most DIP and **Surface Mount** logic devices.
- Low cost optional expansion adaptors for support of any future device packages.
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- Worldwide sales and service.

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(800) 227-8836

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CIRCLE NO 133

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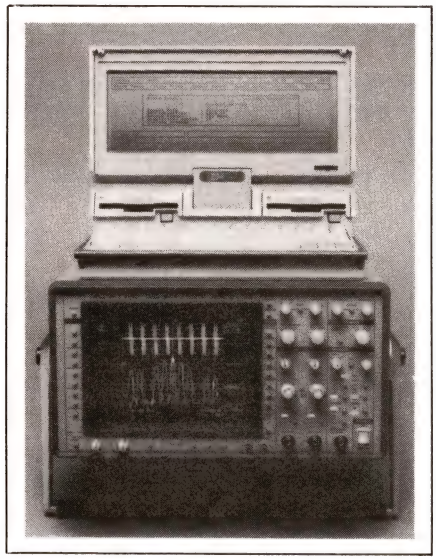
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PENTICA
CIRCLE NO 135

software both support as many as seven drives. From $3495.

Ariel Corp, 110 Greene St, Suite 404, New York, NY 10012. Phone (212) 925-4155. TLX 4997279.

Circle No 611



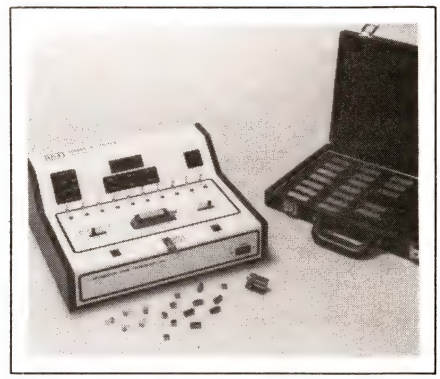
DIGITAL SCOPE

The MS01 mass-storage package adds the laptop IBM PC Convertible's floppy-disk storage capacity—two 720k-byte 3½-in. microfloppy-disk drives—to LeCroy's 9400 digital storage oscilloscope (DSO). The MS01, which includes the IBM PC Convertible, is suitable for storage of full, partial, or segmented scope waveforms in applications that require portability.

The MS02 is suitable for laboratory use and lets you store waveforms on disk in your desktop IBM PC or compatible computer. The MS01's DSO communicates with its IBM PC Converitble at speeds to 220k bytes/sec. The MS02's DSO will communicate with your desktop machine at speeds to 400k bytes, provided your computer is sufficiently fast and employs a National Instruments' IEEE-488 interface board. MS01, $2900; MS02, $600. Delivery, eight weeks ARO.

LeCroy, 700 Chestnut Ridge Rd, Chestnut Ridge, NY 10977. Phone (914) 578-6084.

Circle No 612



LINEAR IC TESTER

The Model 750 μP-based benchtop linear IC tester tests more than 150 types of single, dual, triple, and quad op amps and voltage comparators. It performs both go/no-go and parametric tests on such devices. When performing go/no-go tests on an op amp, the tester first verifies that the device is closed-loop stable. The tester then ascertains whether the device's output can swing to at least 75% of the supply voltage. Next, it measures the device's gain-bandwidth product and compares this measurement against a predetermined limit. When operating in the parametric-measurement mode, the tester can perform 10 types of tests and provide quantitative data; it can run the tests in sequence and can hold the data on its display until you issue a command for it to proceed to the next test. $2495.

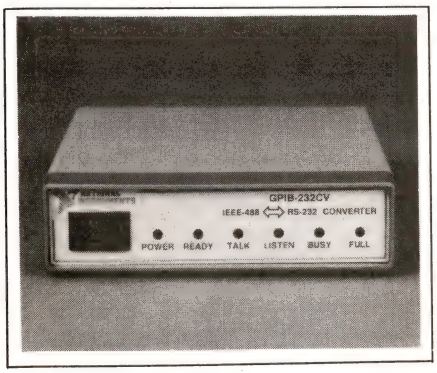
Information Scan Technology Inc, 487 Gianni St, Santa Clara, CA 95054. Phone (408) 988-1908.

Circle No 613

CONVERTERS

The GPIB-232CV and GPIB-422CV allow you to connect RS-232C and RS-422 devices to the IEEE-488 bus. They can interface to IEEE-488 instruments and controllers and provide transparent data conversion in either direction. Each converter is based on a 64180 μP (which features an integral DMA controller) and either a 64k- or 256k-byte buffer. This hardware permits data transferral from bus to buffer at 900k bytes/sec. The unit connected

Instruments



to a converter's serial port controls the rate at which the buffer empties. Each converter's μP automatically interleaves inbound and outbound data transfers. An SRQ_ON_EMPTY feature allows multiple users to share a single RS-232C or RS-422 device. With a 64k-byte buffer, $495; with a 256k-byte buffer, $695.

National Instruments Corp, 12109 Technology Blvd, Austin, TX 78727. Phone (800) 531-4742; in TX, (512) 250-9119. TLX 756737.

Circle No 616



HANDHELD DMM

The 380451 4½-digit handheld multimeter's LCD readout provides dc accuracy of ±0.05% of reading plus two digits. The unit provides visual continuity and low-battery indicators, and a data-hold feature that lets you observe readings after you've disconnected the probes from the circuit under test. You select functions and ranges via a 24-position rotary switch. The meter's ranges cover 200 mV to 1kV ac and dc; 2 mA to 10A ac or dc; and 200Ω to 20 MΩ. A 0Ω adjustment applies to the lowest resistance range only; the other ranges require no adjustment. The meter has a built-in tilt stand for benchtop use. $129.

ExTech Instruments Corp, 150 Bear Hill Rd, Waltham, MA 02154. Phone (617) 890-7440. TLX 940913.

Circle No 614



SWEEP GENERATOR

The Model 6311 programmable sweep generator works with the vendor's automatic amplitude analyzer and autotester to form a scalar network-analysis system. The generator covers a frequency range of 10 MHz to 20 GHz and, in the fast-sweep mode, performs a sweep in 15 msec. When the instrument is producing a constant-frequency output, its frequency accuracy is typically ±3 MHz; during sweeps, its accuracy is ±20 MHz typ.

Its power levels are accurate to ±0.5 dB from 0.01 to 2 GHz. From 2 to 20 GHz, the unit holds harmonics and subharmonics to −40 and −60 dBc min, respectively. The vendor claims that you can calibrate the instrument in 15 minutes by using a counter interfaced to the sweep gen-

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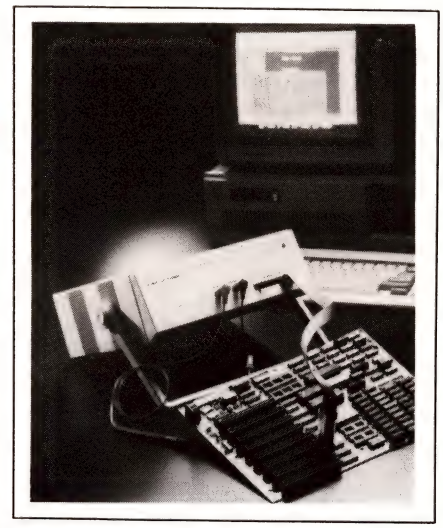
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erator via the IEEE-488 bus, and a power meter. $21,950. Delivery, 60 days ARO.

Marconi Instruments, 3 Pearl Ct, Allendale, NJ 07401. Phone (201) 934-9050.

Circle No 617



PC-BOARD TESTER

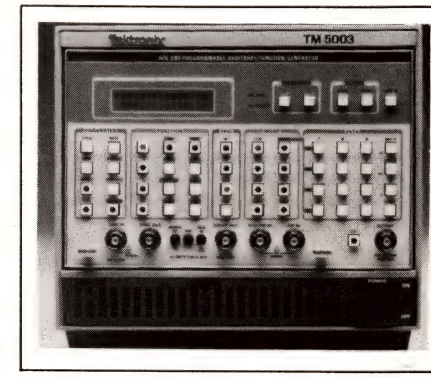
The portable Board Wizard locates defective components on pc boards. It can learn and store characteristic signatures at each pin of known-good boards and devices such as ASICs and PLDs. The tester compares the stored signatures against signatures measured on the board under test. The unit can also conduct comparisons by referring to a library of signatures for 74-series TTL devices. $3495.

Suan Technologies (USA) Inc, 18437 Saticoy St, Suite 8, Reseda, CA 91335. Phone (818) 996-1386.

Circle No 615

FUNCTION GENERATOR

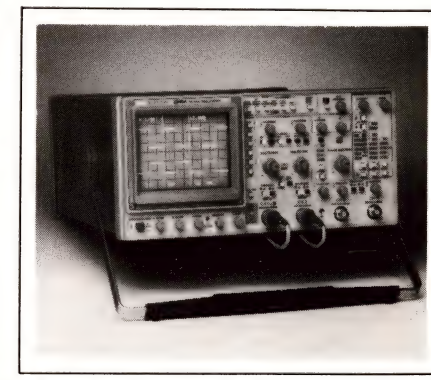
The AFG 5101 modular arbitrary-function generator contains two waveform memories, each of which has 8k×12-bit words. Via its D/A converters, it can output a new value as often as every 100 nsec or as seldom as every 999.9 sec. The unit can also produce sine, square, and triangular waves to 12 MHz. To simplify definition of arbitrary waveforms, the generator's permanent memory contains 1000-point sine, square, triangular, and ramp waveform segments.



You can edit these segments and position them at points of your choosing within the waveform memories. If you define the end points of wavefrom segments, the generator can "draw straight lines" and interconnect them. The instrument can also generate logarithmic, linear, and arbitrarily shaped sweeps; you can select these sweeps and program their starting and stopping points and rates from the panel or via the IEEE-488 interface. $3395. Delivery, 14 weeks ARO.

Tektronix Inc, Box 1700, Beaverton, OR 97077. Phone (800) 835-9433, ext 170.

Circle No 618



100-MHz SCOPES

The 2245A and 2246A oscilloscopes incorporate four 100-MHz-bandwidth channels, two of which provide 2-mV/div sensitivity and 2% max amplitude-display error. By positioning the cursors, you can obtain on-screen numeric readouts of voltage and time. On the 2246A, the

Text continued on pg 213

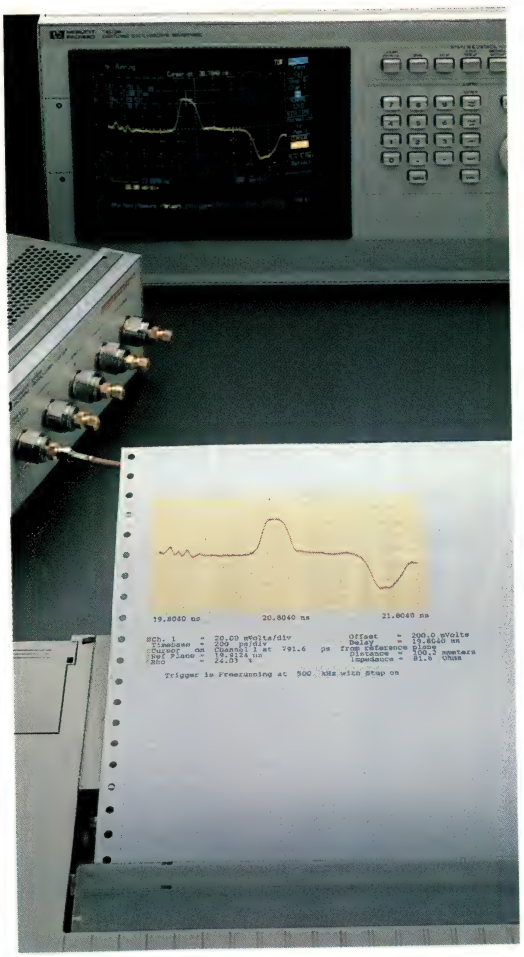
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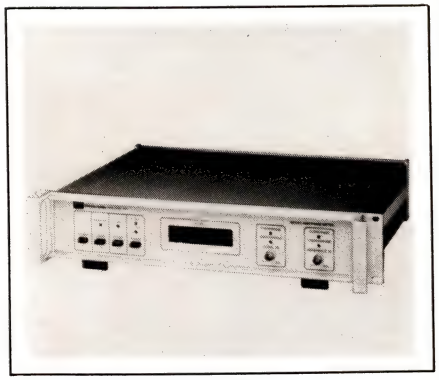
Circle 141 for product demonstration

Circle 142 for product information

cursor settings follow changes in sensitivity, vertical position, and trigger point. Both units offer an automatic-setup feature, which puts a trace on the screen with a minimum of control manipulation. The 2246A also provides on-screen menus from its internal firmware. Further, the 2246A allows you to store 20 control-panel setups and recall them at the touch of a button. 2245A, $1795; 2246A, $2395.

Tektronix Inc, Portable Instruments Div, Box 1700, Beaverton, OR 97077. Phone (800) 835-9433, ext 170.

Circle No 619



DIGITAL PHASE METER

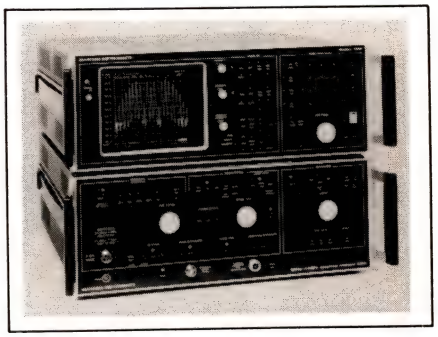
The Model 6000 autoranging digital phase meter includes an IEEE-488 interface. It accepts signals whose amplitudes range from 10 mV to 350V at frequencies from 5 Hz to 500 kHz, with sine, square, or triangular waveforms. The meter's 5-digit LED display can resolve phase changes as small as 0.01° from −180° to +360°. Its accuracy is guaranteed to be better than ±0.05° for sine or square waves. The rear panel has a connector from which you can obtain an analog voltage that's proportional to the measured quantity (the calibration factor is −10 mV/°). The rack-mountable unit measures 19×3.5×14 in. $3295.

Clarke-Hess Communication Research Corp, 220 W 19th St, New York, NY 10011. Phone (212) 255-2940.

Circle No 621

SPECTRUM ANALYZER

The 2383 spectrum analyzer covers the frequency range from 100 Hz to 4.2 GHz and can display a full-bandwidth sweep on a single screen. Its minimum resolution bandwidth is 3 Hz and its high-level accuracy is ±1.5 dB with any control settings and at any specified operating temperature, even at 4.2 GHz. Its built-in



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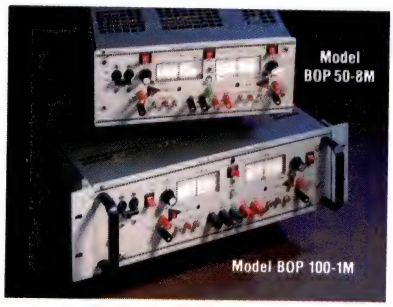


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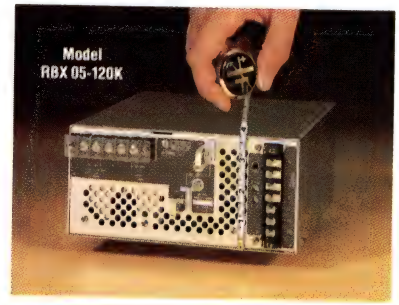
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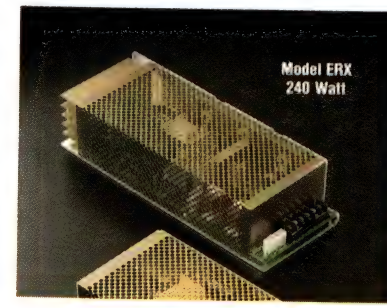
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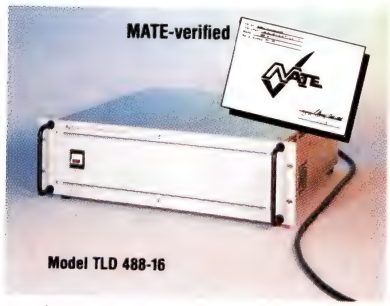
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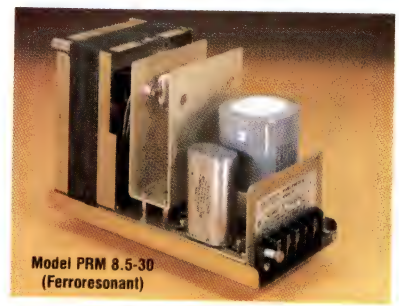
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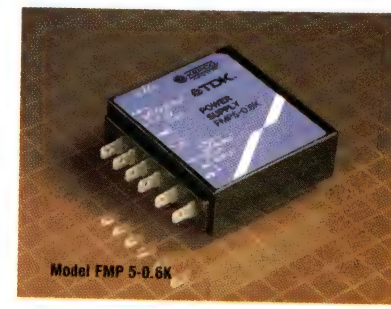
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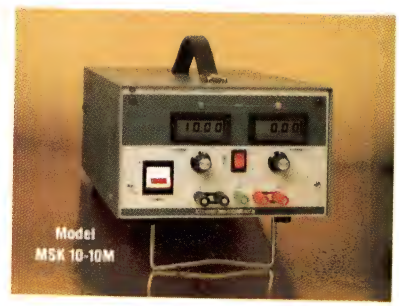
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Marconi Instruments, 3 Pearl Ct, Allendale, NJ 07401. Phone (201) 934-9050.

Circle No 620

IEEE-488 CONTROLLERS

The HP PC 305 and 308 are turnkey instrument-control systems based on the vendor's Vectra family of MS-DOS-based personal computers.



They incorporate a Basic language coprocessor, a plug-in card that includes—in addition to an IEEE-488 interface—a 68000 coprocessor with 512k bytes of RAM separate from the Vectras' system RAM, and ROMs containing the HP Basic 5.0 language.

HP Basic is an advanced dialect that supports structured programming constructs and includes a rich set of instrument-control instructions. The coprocessor can utilize system RAM as a RAMdisk. Once you have acquired data from IEEE-488-based instruments connected to the coprocessor card, you can analyze it on the same system with any of the commercially available data-analysis packages that run under MS-DOS on the 8086 or 80286 μP. $3895 to $6695, depending on type of display and whether the system includes a hard disk.

Hewlett-Packard Co, 1820 Embarcadero Rd, Palo Alto, CA 94303. Phone local office.

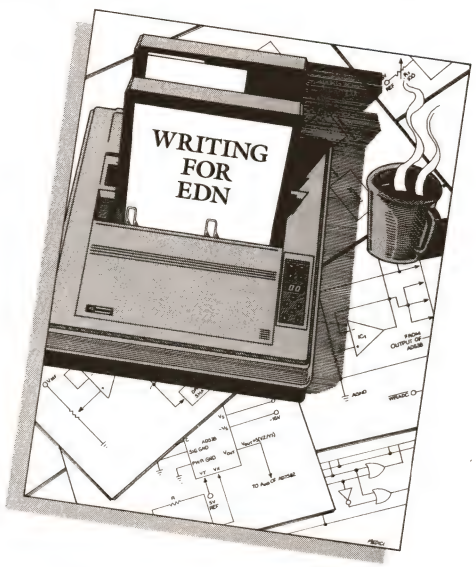
Circle No 622

POWER ANALYZER

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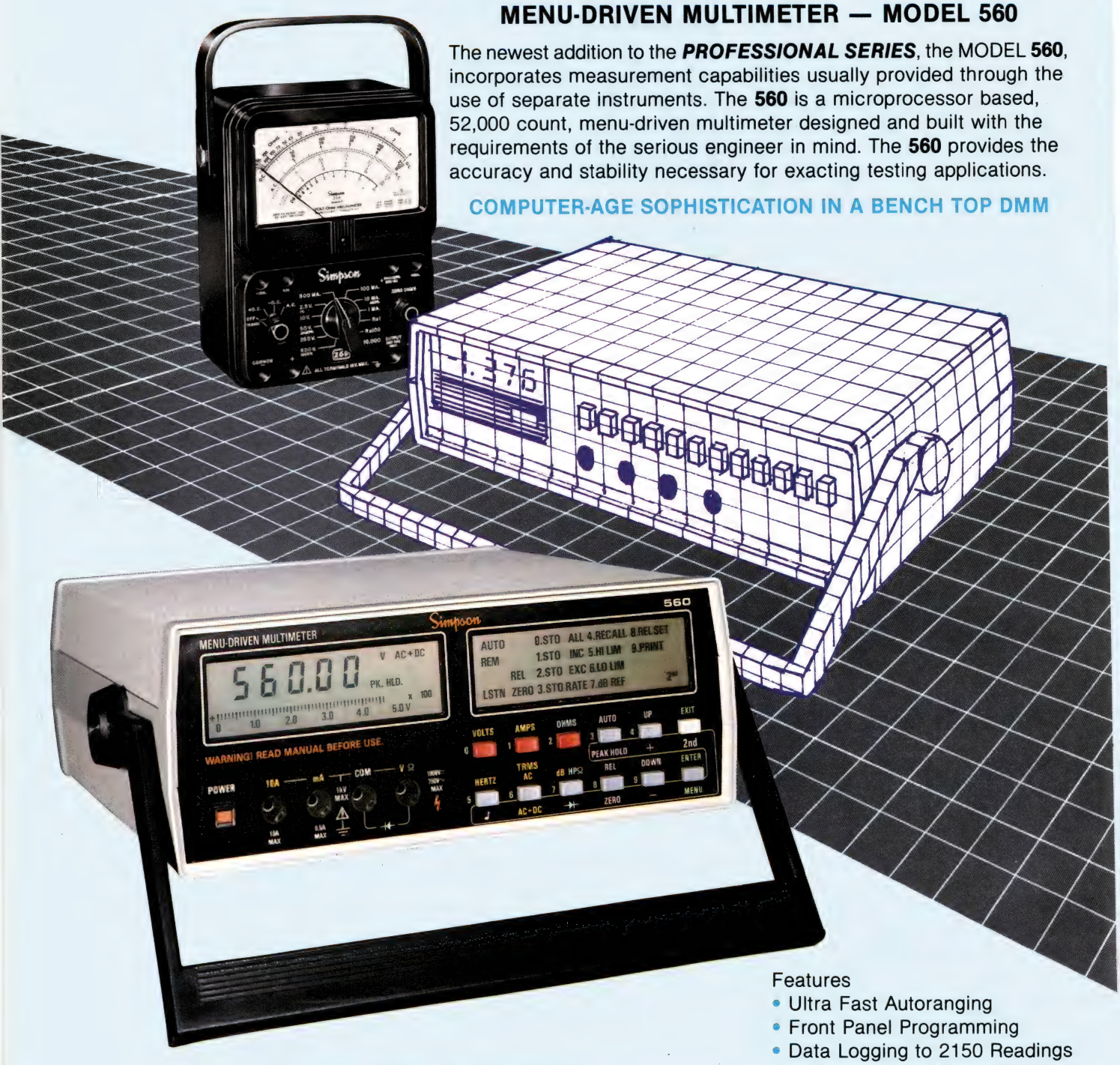
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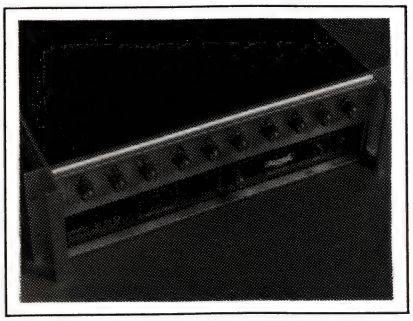
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most measurements, accuracy is 0.05% of reading. Besides true-rms voltage and current, the variables measured include real, complex, and reactive "power" (watts, VA, and VARs), watt-hours, VAR-hours, power factor, and frequency. Measurement ranges extend from 4 to 660V, 25 mA to 55A, and 150 mW to 36 kW. An IEEE-488 interface is optional. $7500.

Dowty RFL Industries Inc, Powerville Rd, Boonton, NJ 07005. Phone (800) 242-7421; in NJ, (201) 334-3100.

Circle No 623



SYNTHESIZERS

The PTS 040, 160, 250, and 500 are frequency synthesizers whose model numbers indicate their maximum output frequencies. Each model's primary output, whose frequency you can control from the front panel or via BCD inputs, has a level that you can vary from 3 to 13 dBm. In addition to the primary output, each unit also provides a second 3-dBm frequency-synthesized output, referenced to the same frequency standard as the primary output and remotely programmable in 1-Hz steps from 0.1 to 3.0 MHz.

You can choose an oven-stabilized crystal or a temperature-compensated crystal (TCXO) as the standard; you can also connect your own 5- or 10-MHz frequency reference. Each synthesizer features phase-continuous frequency switching. On the primary output, frequency switching occurs within 5 to 20 μsec of the command; on the secondary output, it occurs within 1 μsec. 160-MHz unit with TCXO, $5400.

Programmed Test Sources Inc, Box 517, Littleton, MA 01460. Phone (617) 486-3008.

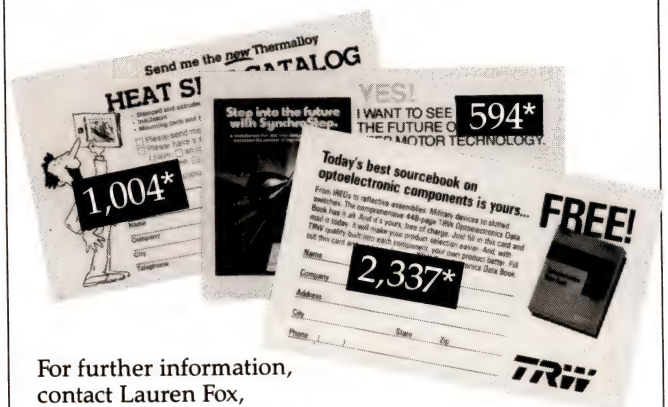
Circle No 625

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The dual-channel Model 1020 provides all of the oscilloscope functions required in many applications. The instrument has an 8×10-cm viewing area with an illuminated internal graticule, a 20-MHz bandwidth, and

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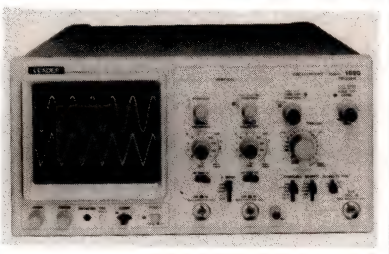


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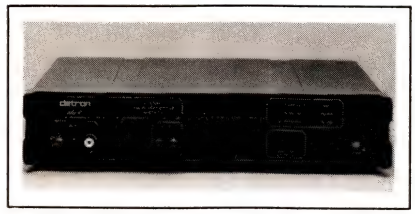
maximum sensitivity of 0.5 mV/div. Trigger capabilities include alternate-channel triggering, variable trigger holdoff, TV-sync separation, and line triggering. $595.

Leader Instruments Corp, 380 Oser Ave, Hauppauge, NY 11788. Phone (800) 645-5104; in NY, (516) 231-6900. TWX 510-227-9669.

Circle No 624

CURRENT CALIBRATOR

The 4600 transconductance amplifier extends the dc and rms ac current ranges of the company's 4700 Series multifunction calibrators to 11A.



When used with these calibrators, the unit is programmable via the calibrator's IEEE-488 interface. Or, you can use the unit as a stand-alone transconductance amplifier with a transfer characteristic of 1A dc or rms ac output for 1V dc or rms ac input.

Total dc uncertainty relative to the input voltage is ±(105 ppm of output +500 μA) for a calibration interval of 90 days and a temperature range of 23±1°C. Total ac uncertainty for the same conditions is ±(330 ppm of output + 1.2 mA) over the frequency range 10 Hz to 1 kHz, and ±(1000 ppm of output + 1.6 mA) over the frequency range 1 to 5 kHz.

The temperature coefficients for dc and ac outputs are 10 ppm/°C and 20 ppm/°C, respectively. Distortion levels for ac outputs are 0.2% and 0.5% over the 10-Hz to 1-kHz and the 1 to 5 kHz frequency ranges, respectively. The unit's input impedance is 300 kΩ in parallel with 100 pF, and its output compliance is greater than 2V. When you use the unit in stand-alone mode, you calibrate it with trimpots; when you use it with 4700 Series calibrators, you can use the calibrators' autocal facility to calibrate the 4600. $3995. Delivery, six weeks ARO.

Datron Instruments Ltd, Hurricane Way, Norwich Airport Industrial Estate, Norwich NR6 6JB, UK. Phone (0603) 404824. TLX 975173.

Circle No 641

Wavetek Corp, Box 85434, San Diego, CA 92138. Phone (619) 450-9971. TLX 756953.

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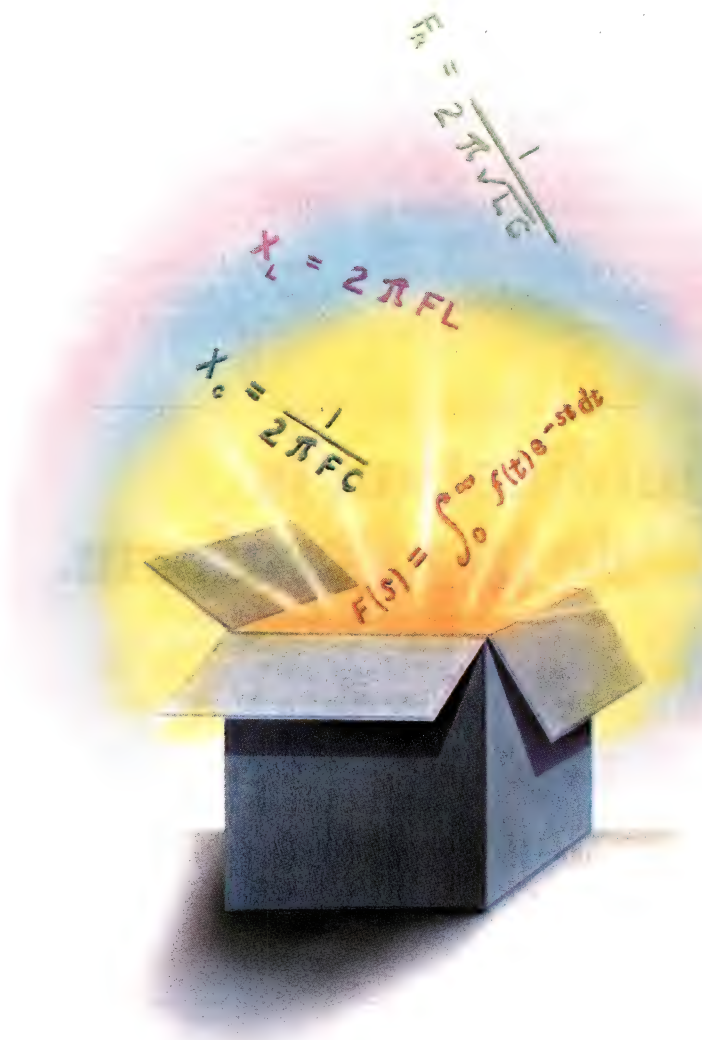
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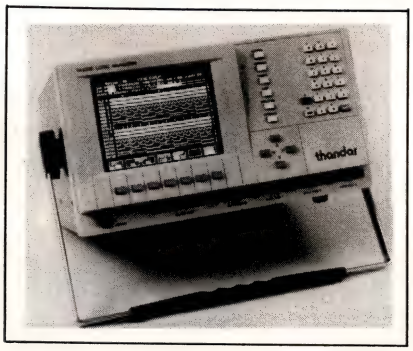
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CIRCLE NO 151

Instruments



LOGIC ANALYZER

The TA1000 logic analyzer provides you with 32 25-MHz state/timing channels. Trace memory amounts to 1k bit/channel, and external clock facilities include three independent clock inputs and five clock qualifiers. You can define as many as four 32-bit trigger/restart words, which you can OR together in each step of a 4-step trigger sequencer. Each step of the trigger sequencer also includes a 1 to 256 event counter.

You can display timing or state information on the analyzer's 7-in. CRT and analyze it, using the instrument's trace expansion facilities, two screen cursors, and reference memory. You can also perform automatic trace/reference memory comparisons on any portion of the traced data, optionally stopping trace acquisition on trace/reference equality or inequality, or counting the occurrences of these conditions.

The instrument includes IEEE-488, RS-232C, and Centronics interfaces, and nonvolatile memory for captured data, reference data, and 16 instrument setups as standard. Disassemblers for a range of 8- and 16-bit μPs are available as options. With TTL-threshold input pods, £1790; with variable threshold pods, £2250.

Thandar Electronics Ltd, London Rd, St Ives, Huntingdon, Cambridgeshire PE17 4HJ, UK. Phone (0480) 64646. TLX 32250.

Circle No 640

BENCHTOP ATE

Operating in conjunction with an IBM PC or compatible computer, the 635 benchtop service diagnostic tester combines analog and digital test capabilities with ease of use. The instrument can make digital tests on all logic families and performs a wide range of analog functional measurements. The tester



comes in two basic versions of the tester: the 635A and 635B. The 635B provides both test- and program-generation facilities, but the 635A can only execute test programs. You program the 635B,

Text continued on pg 226

EDN NEWS



HOT NEWS OF PRODUCTS, TECHNOLOGY, AND CAREERS

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You can obtain EDN designer's guides to semicustom integrated circuits, CMOS ICs, and innovative linear circuits.

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A close look at digital testers will give you a new Outlook for design verification.

The DAS 9200 from Tektronix is a high performance digital test system. But for even higher performance, take a close look at the T-100 from Outlook Technology.

Both products have a maximum recording clock of 2 GHz. But only the T-100 uses intelligent sampling for precise data recording with 100 ps resolution. That's up to five times the resolution of the 9200... the difference between just seeing what happened and finding out why.

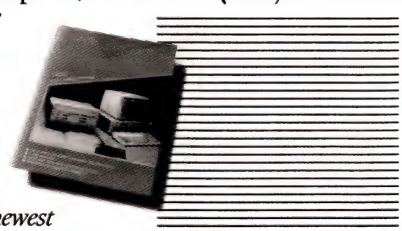
Both instruments find timing problems, but only the T-100 can trigger on and track down setup and hold time violations to save countless hours of searching for logic problems.

Both products can be used in automated setups to test boards and chips at high speed and high resolution. But the T-100 can perform up to ten times more tests per hour. And it can act as a 250 MHz pattern generator (stimulus), 250 MHz logic recorder (response), or both.

The T-100 also comes with a friendly human interface, including LogicProbe, a new utility program that makes setup and use faster and easier than ever before.

For a new outlook on digital testing, look into the T-100 family, with prices starting at just $15,000. Contact Outlook Technology, Inc., 200 E. Hacienda Ave., Campbell, CA 95008 (408) 374-2990.

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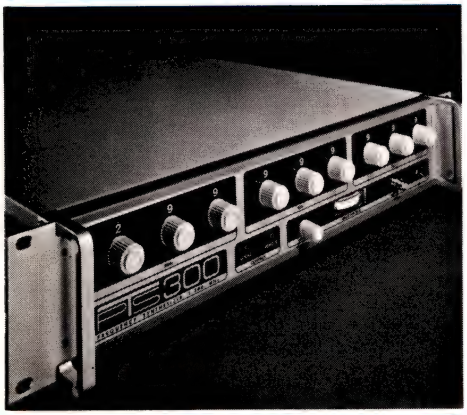
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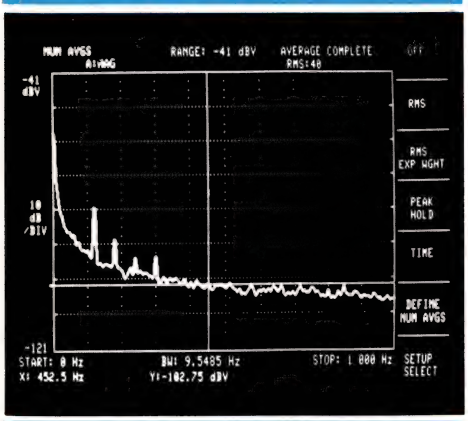
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CIRCLE NO 155

using the company's Board Test Language that runs under the Xenix operating system. The tester is upwardly compatible with existing programs for the company's model-3000C and -3500 service test systems, and its Series-30 manufacturing test systems.

You can specify as many as 128 500-mA test pins, each backed by a 1k×4-bit RAM, and each incorporating a 16-bit CRC signature facility and a 4-MHz test-pattern rate. Analog test facilities include high-frequency measurement, a short-circuit locator, and two independent ac stimulus/measurement channels. Basic configurations from £25,000 to £45,000.

Schlumberger-Solartron, Victoria Rd, Farnborough, Hampshire GU14 7PW, UK. Phone (0252) 544433. TLX 858245.

Circle No 638

Schlumberger Instruments, 20 North Ave, Burlington, MA 01803. Phone (617) 229-4825.

Circle No 639

HANDHELD DMMs

The DM Series handheld autoranging digital multimeters comprises four models: the DM60, DM62-RMS, DM64-RMS, and DM66-RMS. The DM60, DM62-RMS, and DM64-RMS are 4-digit models offering dc voltage ranges from 100 mV to 1 kV; ac voltage ranges from 1 to 750V; dc or ac current ranges from 10 mA to 10A (1 mA to 10A for the DM64-RMS); and resistance measurement ranges from 100Ω to 100 MΩ. The DM66-RMS is a 4½-digit model with equivalent bottom ranges of 200 mV, 2V, 2 mA, and 200Ω, respectively.

In addition to their digital displays, all the models feature an analog scale in the LCD area with a maximum resolution of 2 mV/div. Suffix -RMS models measure the true-rms value of nonsinusoidal waveforms, and also offer relative measurement, storage/recall of measured values, and storage of threshold values, as well as a continuity test buzzer and display illumination. The DM64-RMS and DM66-RMS can also measure dB ratios, frequencies from 1 Hz to 100 kHz, and temperatures from −20 to +1200°C. These two models also offer autoranging or manual ranging, analog scale magnification, and keyboard entry of threshold and reference values. The DM66-RMS also features storage of measured values during preselected time intervals. An optional interface unit allows you to control the DMMs via an IEEE-488, RS-232C, or Centronics interface. From DM 430 to DM 956.

Grundig AG, Würzburger Strasse 150, 8510 Fürth/Bay, West Germany. Phone (0911) 73301. TLX 623435.

Circle No 643



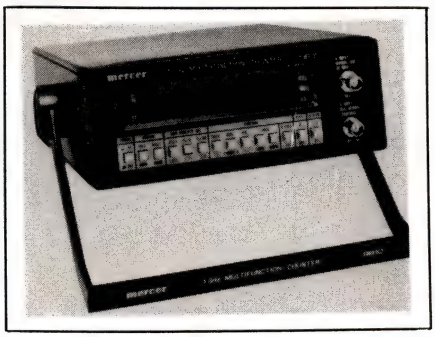
RTD SIMULATOR

The handheld, battery-powered RTD-700 can measure and simulate 2-, 3-, and 4-wire resistance temperature detectors (RTDs), or resistance thermometers. The unit operates in either Celsius or Fahrenheit mode, covers the temperature range from −200 to +850°C, and offers

four digits of resolution, with simulation accuracy of ±0.1% of setting and readout accuracy of ±(0.1%+0.1Ω). The unit uses an industry-accepted test-current value of 1 mA to minimize the effects of self-heating of the detector. $725.

General Resistance Co, Box 185, North Branford, CT 06471. Phone (203) 481-5721.

Circle No 627



FREQUENCY COUNTERS

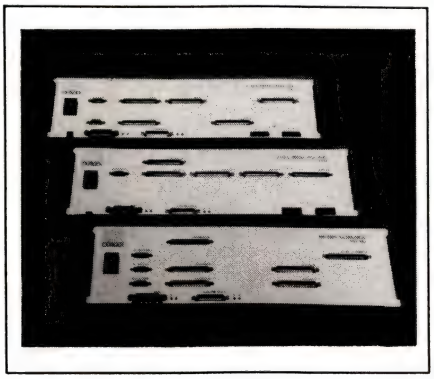
Including reference ovens that hold timebase temperature coefficients to $\pm 10^{-6}$ from 0 to 40°C, and offering timebase aging of $\pm 3 \times 10^{-7}$/month, the 9800 and 9810 frequency counters cover 10 Hz to 100 MHz and 10 Hz to 1 GHz, respectively. Eight 7-segment LED digits display the readings. All inputs to the counters occur via front-panel connectors. A 1-MΩ input provides sensitivity of 25 mV rms at 5 MHz and below, and of 50 mV rms from 5 to 100 MHz. The 9810 has a separate 50Ω input that accepts high-frequency signals from 15 mV rms to 3V peak. Above 10 MHz, the counters use a 10:1 prescaler to divide the input frequency. 9800, $255; 9810, $475.

Mercer Electronics, 859 Dundee Ave, Elgin, IL 60120. Phone (312) 697-2260. TLX 722416.

Circle No 626

TIMING INSTRUMENTS

The T-132 logic timing analyzer provides a maximum of 32 channels. Depending on the number of channels installed, it makes timing measurements at either 250 or 500 MHz. The PG-132 is a 32-channel, 250-MHz pattern generator. The T-116 provides 16 channels of 500-MHz timing analysis and 250-MHz pattern generation. The configuration of the timing analyzers determines their maximum memory depth; they can have 4 to 16k words of memory. The pattern generators offer 4k-word memory depth, but they can generate repetitive patterns of infinite length.



An equivalent-time sampling option endows the T-132 with 100-psec resolution for measurements on repetitive waveforms. Another T-132 option lets it capture setup and hold-time violations, a capability that is standard on the T-116. You can position the capture window from 4 nsec before to 16 nsec after an external clock's active edge, and you can make the window width as long as 1.5 nsec, in 200-psec increments. $14,750 to $19,750.

Outlook Technology Inc, 200 E Hacienda Ave, Campbell, CA 95008. Phone (408) 374-2990. TLX 350479.

Circle No 628

8-CHANNEL RECORDER

The MT-9500 8-channel oscillographic recorder's only moving parts are its chart drive and thermal imaging paper. It can reproduce 3-kHz analog signals with negligible attenuation; at 5 kHz, its response is −3 dB. The unit digitizes data with 12-bit precision at 32k samples/sec. Every msec, it energizes the elements in its stationary printhead

Text continued on pg 230

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Model 520/A

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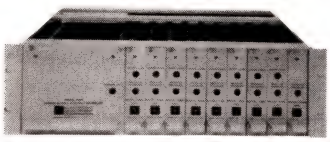
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Specifications include: Range: 10 mV to 30 Vac resolved to 1 mV. The compliance current is: 50 mA. The accuracy is: ± (0.05% of setting + 15 mV). Output frequency (synchronized to an external sine wave stimulus): at a selected, fixed frequencies between 10 Hz and 400 Hz.

Price: Main frame: $3,995
Output modules: $895/each

Engineering Contact: **Bob Ross**
Tel: (617) 268-9696
FAX: (617) 268-6754 **CIRCLE NO 160**

ELECTRONIC DEVELOPMENT CORP.
11 Hamlin St., Boston, MA 02127
Tel: (617) 268-9696
TLX: 951596 (ELECDEVCO BSN)

Instruments

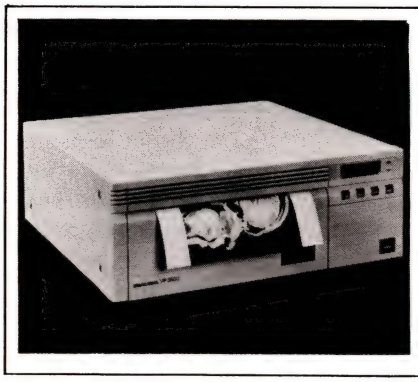


that span the highest and lowest amplitudes achieved by each signal during the last 32 samples. The printing elements are spaced 0.005 in. apart.

You can select the side-by-side display of 40-mm-wide channels or the overlapping display of two groups of four channels, each in a 160-mm-wide area. The stepper-motor chart drive allows you to advance the roll or Z-fold paper, at any integer value of speed, to run at 150 or 200 mm/sec or to run from 1 to 100 mm/sec, minute, or hour. The unit prints the chart grids along with the data and includes facilities for event marking, time coding, and annotation. $12,950. Delivery, four to six weeks ARO.

Astro-Med Inc, Astro-Med Industrial Park, West Warwick, RI 02893. Phone (800) 343-4039; in RI, (401) 828-4000. TWX 710-382-6409.

Circle No 631



VIDEO PRINTER

The VP-3500 video printer provides 1280×1250 pixels of resolution at 300 dots/in. with a 64-tone gray scale on 8.5-in.-wide, thermal-print paper. It connects to computer CRT terminals, TV cameras, and image-processing systems. The unit lets you select white-on-black or black-on-white printing and includes a frame buffer for storing images to be printed. Its front panel sports a 32-character LCD display. $6700.

Seikosha America Inc, 1111 MacArthur Blvd, Mahwah, NJ 07430. Phone (800) 422-7768; in NJ, (201) 529-4655.

Circle No 629



AUDIO OSCILLATOR

The model 1110 audio oscillator can deliver as much as 25 dBm into 600Ω, 29 dBm into 150 Ω, or 31 dBm into 50Ω. Pushbutton control programs a single pair of BNC output connectors for floating or single-ended operation, with 50, 150, or 600Ω output impedance. The frequency range is 10 Hz to 150 kHz, with 0.001-Hz resolution. The typical distortion is 0.001%.

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Boonton Electronics Corp, 791 Rte 10, Randolph, NJ 07869. Phone (201) 584-1077.

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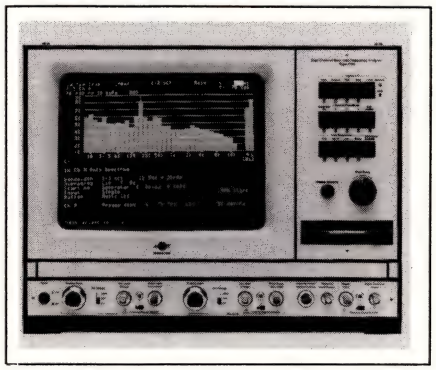
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CIRCLE NO 162

FREQUENCY ANALYZER

The Model 2133 frequency analyzer can perform real-time analysis of acoustic and vibration frequencies as high as 22 kHz, in bands as narrow as 1/24 octave. An internal buffer memory holds more than 1000 1/3-octave spectra, and a built-in, MS-DOS compatible floppy disk provides additional storage. This storage allows the instrument to perform most calculations onboard,



eliminating the need to offload data for processing by an external computer.

The memory also enables single-keystroke access to the most frequently used test and display routines, and aids in transferring data to PC-based applications programs such as spreadsheets and report generators. The analyzer, available in single- and dual-channel versions, uses 14-bit A/D converters to achieve an 80-dB dynamic range. Other features include self-calibration, IEEE-488 interface, direct hard-copy output, and a noise generator with pink, white, random, pseudorandom, and burst modes. Dual-channel 2133, $34,000; single-channel 2123, $22,500.

Bruel & Kjaer Instruments Inc, 185 Forest Street, Marlborough, MA 01752. Phone (617) 481-7000.

Circle No 633

POWER CALIBRATOR

The 800LPF is a standard for calibrating instruments that measure power at ac line frequencies. It works with instruments that accept 10 to 700V rms and 100 mA to 50A



rms—that is, 1W to 35 kW, at 50, 60, and 400 Hz. It maintains its ±0.015% error spec at power factors as low as 0.01. You can obtain units with an IEEE-488 interface. $12,000 to $14,000. Delivery, 90 to 120 days ARO.

Rotek Instrument Corp, 390 Main St, Waltham, MA 02154. Phone (617) 899-4611.

Circle No 632

SPECTRUM ANALYZER

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Rohde & Schwarz Inc, 4425 Nicole Dr, Lanham, MD 20706. Phone (301) 459-8800. TWX 510-223-0414.

Circle No 637

SMALL NEWS



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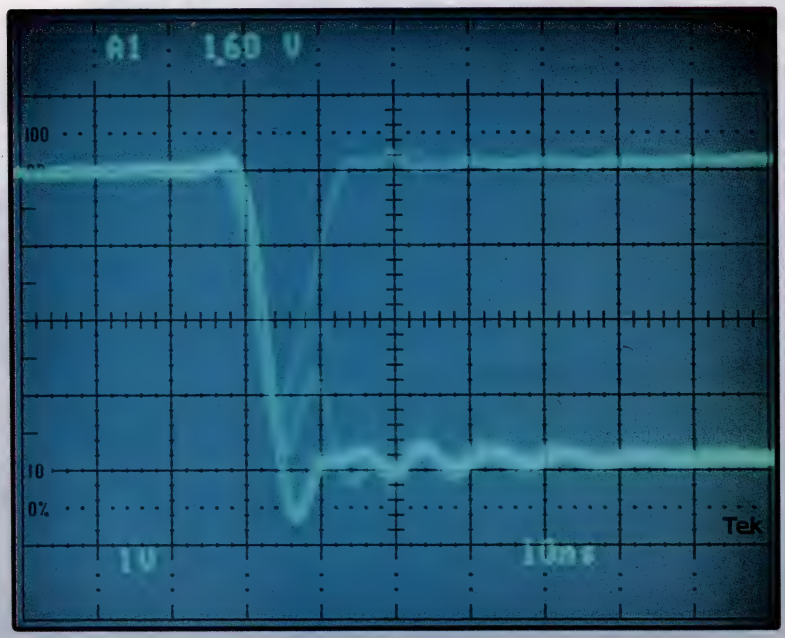
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CIRCLE NO 163

SINGLE-SHOT PULSES TO 350 MHz



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Now you can locate elusive glitches, pulses and infrequent events other scopes fail to show—using the 350 MHz Tek 2467 Transient Intensifying Oscilloscope.

350 MHz Tek 2467.

The 2467's 4 cm/ns visual writing speed is *100 times faster* than that of any other portable instrument, thanks to Tek's patented microchannel plate CRT.

What it displays, competitors don't even see.

The result: you see everything that happens in your circuit, whether it occurs once or repetitively. Including asynchronous noise, crosstalk, bus contention, marginal timing, metastability and even the one-in-a-million anomaly.

Because the 2467 specifies *visual* writing speed, not the *photographic* writing speed of other scopes, you can view all faults in normal room light. You don't need a viewing hood. Being able to pinpoint problems this readily makes the critical difference in many troubleshooting situations.

In short, seeing is believing.

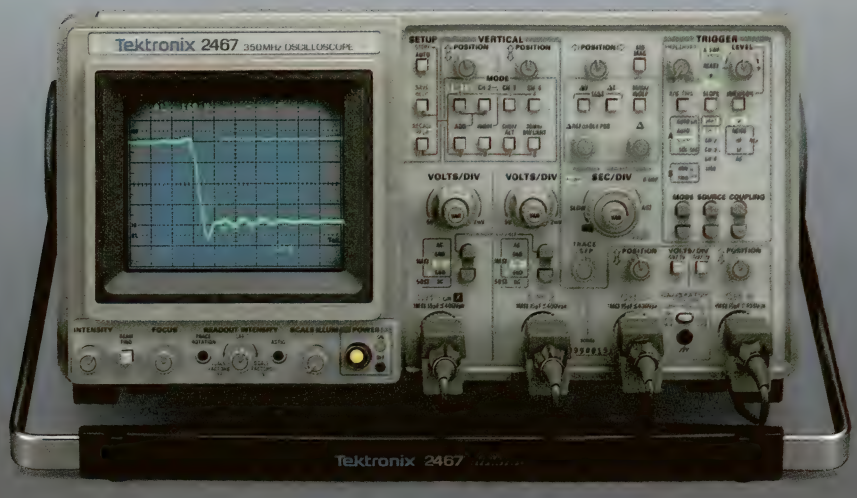
Four independent channels, 500 ps/div sweep speeds, 1% timing accuracy and 2% vertical accuracy enhance the 2467's problem-solving power.

Built-in automation features help speed your troubleshooting even more and make this one of the easiest scopes to use. It sets up in seconds, for example, at the push of a button.

A complete measurement package that sets up in seconds.

Ask your Tek representative for a 2467 demonstration—and see just what you've been missing. For additional information, return the reply card or call Tek direct: **1-800-426-2200.**

When the measurement counts, count on Tek.

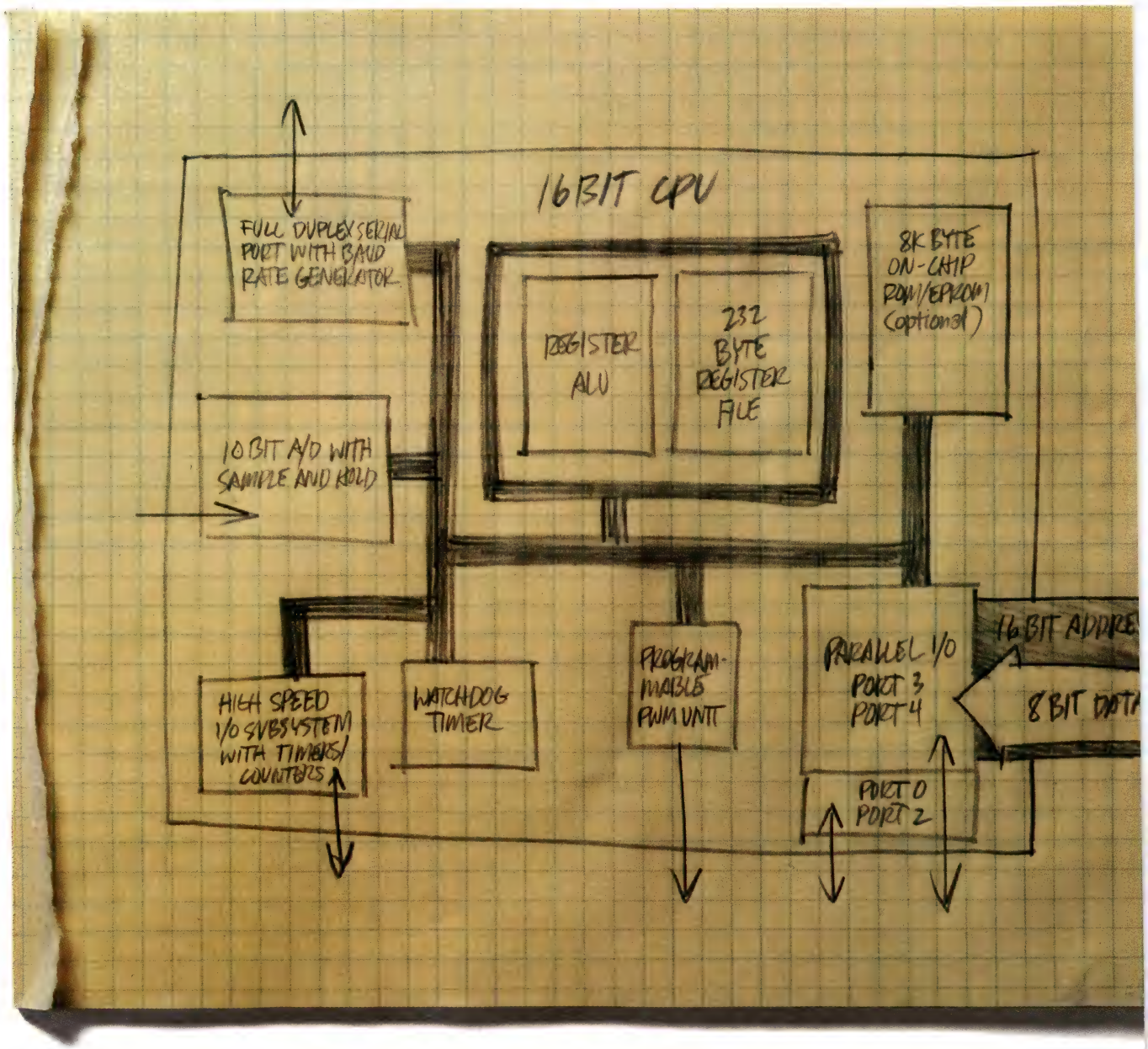


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CIRCLE NO 164

MEET THE BRAINS BEHIND INTEL'S NEW 8-BIT MICROCONTROLLER.

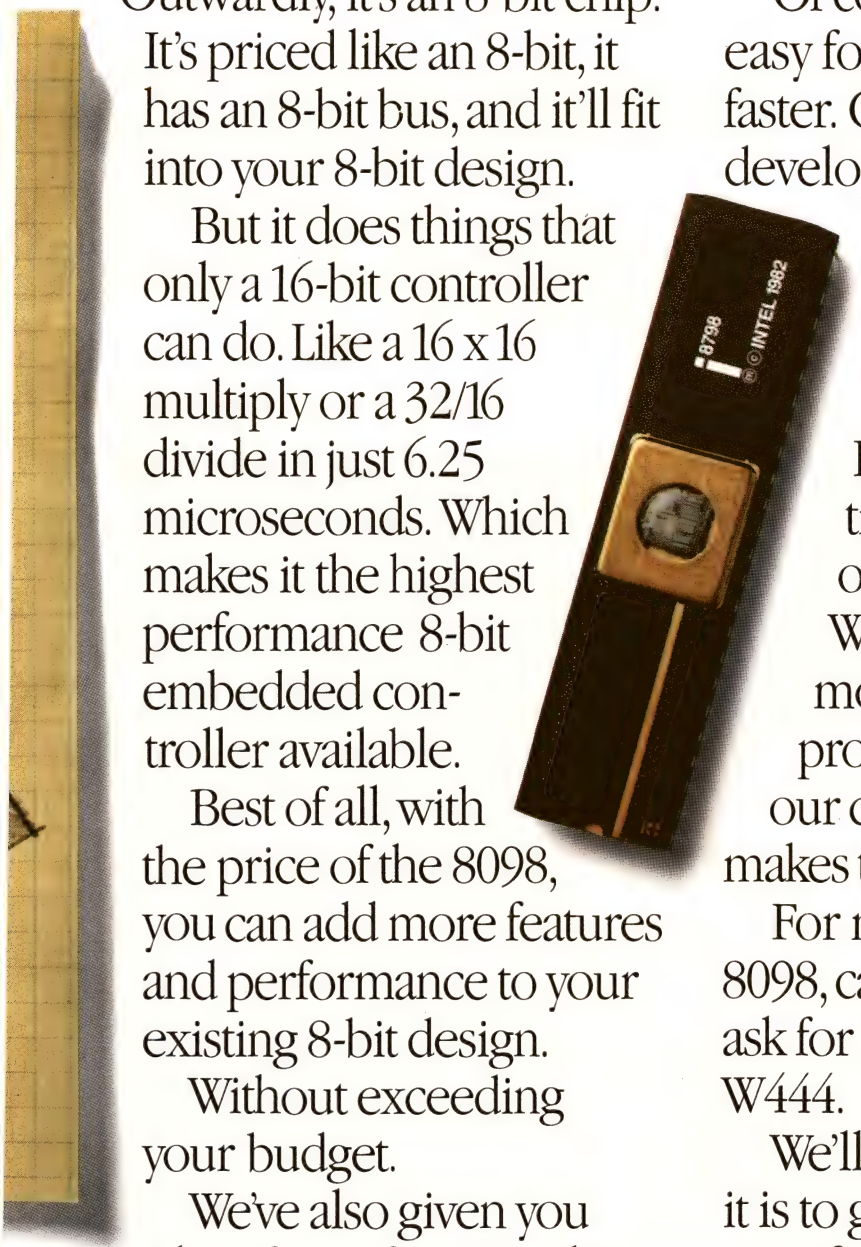


OUR 16-BIT CPU.

If you could use a lot more performance, but system cost and board space are limiting you to an 8-bit design, our new 8098 microcontroller is the most intelligent solution yet.

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But it does things that only a 16-bit controller can do. Like a 16 x 16 multiply or a 32/16 divide in just 6.25 microseconds. Which makes it the highest performance 8-bit embedded controller available.



Best of all, with the price of the 8098, you can add more features and performance to your existing 8-bit design.

Without exceeding your budget.

We've also given you a lot of new functionality to work with. The 8098 has on-chip peripherals, like a 10-bit A/D converter, serial port, and high-speed I/O. There's also on-board RAM. And versions available with ROM and EPROM. So you have the flexibility to add more features to your design.

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And comes with an affordable price. Our Field Application Engineers give you training seminars and on-site technical support. Which helps you design more sophisticated products in less time. And our complete documentation makes the process even simpler.

For more information on the 8098, call (800) 548-4725, and ask for Literature Department W444.

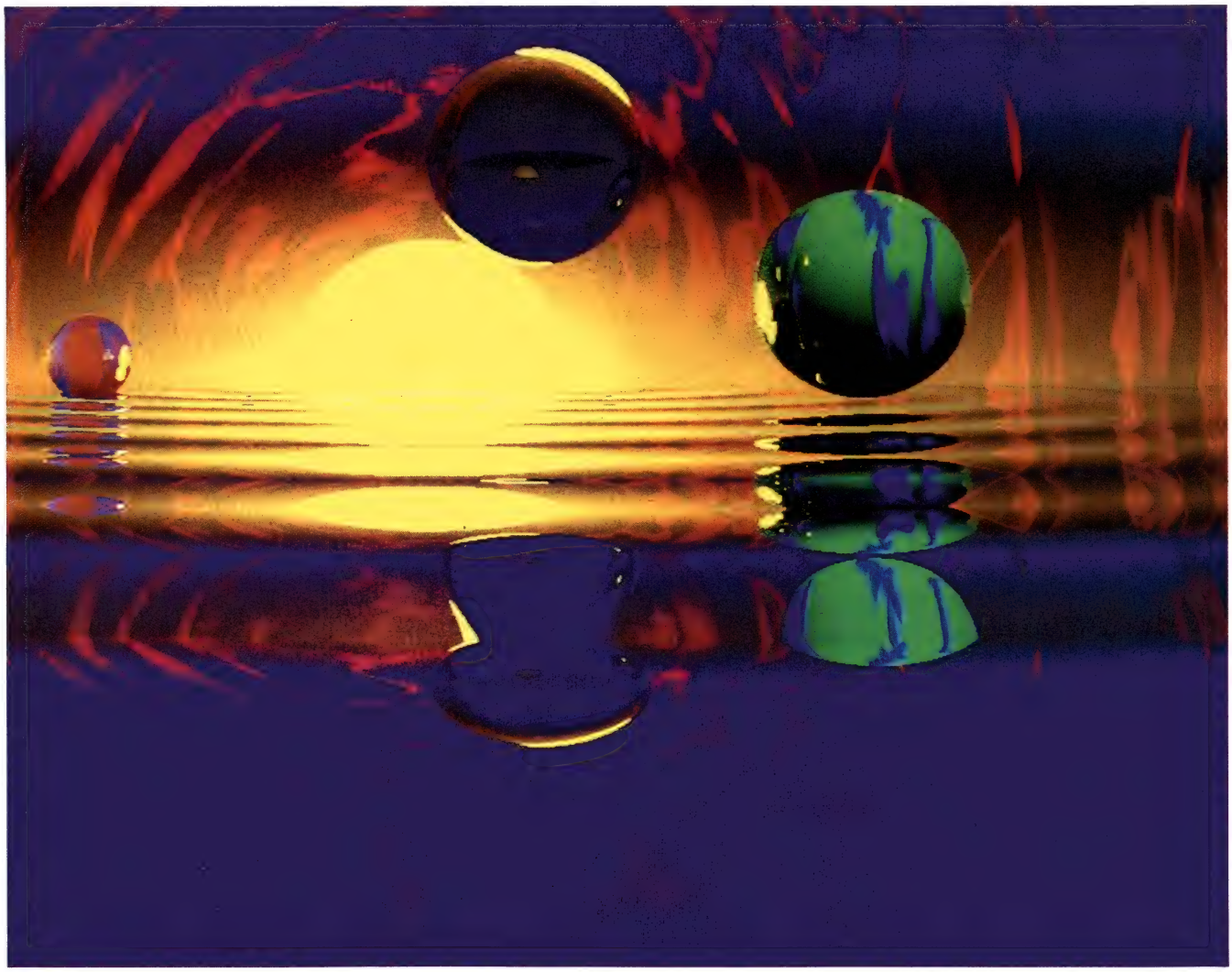
We'll show you how easy it is to get 16-bit performance out of your 8-bit budget.

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CIRCLE NO 166

Add-in μP boards break various hosts' speed limits



John Gallant, *Associate Editor*

The increasing demands for more computational power can make you wonder whether you've outgrown your system. In some cases, add-in processor boards, including some that offer parallel architectures, can relieve you of the time and expense involved in buying a more expensive, completely new machine. Frequently you can solve your problem by adding one of these boards to your computer in the same way you'd put a new addition on your house to avoid assuming on a larger mortgage.

Boards that contain the 80386 μP are really a subject unto themselves—and a large one at that. What follows is a discussion of some representative boards that offer different 32-bit CPUs for such popular systems as the IBM PC, PC/XT, and PC/AT; the Macintosh; the MicroVAX; and the Sun workstations. They illustrate well the kinds of options available in the marketplace today.

The ubiquitous IBM PC and its compatibles are good examples of computers that are being asked to perform beyond their original capabilities. Many of these computers are functioning as multiuser, workstation, and specialized machines. And those general-purpose computers are now finding their way into such specific applications as office automation, CAD/CAM/CAE, software development, AI systems, network file servers, and gateway machines.

Before you trade in your computer for this year's latest model, consider adding a high-speed μP board to meet your expanding computing requirements. These boards, including some that offer parallel operations, can increase the power of the machine you already have—often ten- to twentyfold.

The Series 200 PM from Opus Systems is an add-in processor board for the IBM PC/AT for multiuser and engineering workstation applications. It contains a National Semiconductor 32-bit NS32332 μP, an NS32382 memory-management unit, and an NS32081 floating-point-math unit. In this configuration, the NS32332 actually becomes the system processor, running AT&T's System V Unix, while the resident host processor acts as an I/O processor in a dual-processor architecture. An I/O executive transforms the PC/AT from its normal function as a personal computer into the dedicated I/O resource for use by the board. The NS32382 can access a maximum of 4G bytes of demand-paged virtual memory.

You can order the 200 PM with 4M, 8M, or 16M bytes of main memory. A memory controller provides dual-ported priority access for the I/O processor and system processor, respectively. The I/O processor can access the memory directly or via a PC/AT DMA channel. In addition, the board's Unix operating system can read MS-DOS files and some MS-DOS utilities. A standard library of I/O software contains drivers for bit-mapped graphics, multiport serial communications, high-capacity disks, a 9-track tape, and a ¼-in. streaming-tape cartridge.

Mercury's MC3200AT board for the IBM PC/AT accelerates any C or Fortran program, but it's designed particularly for those programs that have a lot of floating-point computations. Based on Weitek's XL series of CPU chips, it consists of a 20M-flops, 32-bit floating-point-math unit, a 32-bit integer processor, and a 32-bit program sequencer; these three units can execute instructions in parallel at 10 MHz. The host communicates with the board via a slave interface. The host CPU handles multitasking and system calls while the board does number crunching simultaneously. The board can have as much as 2M bytes of main memory, expandable to 10M bytes with the use of a daughter board. Fortran and C compilers generate assembly code, which is then partitioned into the microcode fields and synchronized for the various processors.

DSP puts you in the frequency domain

If you want your computer to tackle digital signal processing (DSP) or image processing, a plug-in array-processor board can help. The DSP32-PC floating-point array-processor board from Communications Automation & Control turns your IBM PC and PC/XT into a DSP workstation. The board contains an AT&T DSP32 32-bit digital signal processor that runs at 16 MHz and performs 8M flops. It also contains 128k bytes of static RAM with a 70-nsec access time and an 8-bit codec connected to an I/O interface. A jumper block lets you connect the codec to a modular phone jack, or you can

A 1024×768 graphics display generated on a Macintosh II using an add-in processor board *(Levco)*

The IBM PC and compatibles are good examples of computers that are being asked to perform beyond their original capabilities.

use the jumper block to connect the DSP chip's serial 8M-bps serial I/O channel to an external A/D or D/A device. An IBM PC/AT version with a DSP32C chip that delivers 25M flops with 64k bytes of static RAM will be available in the fourth quarter of this year.

An array-processor board from Causal Systems for the IBM PC, PC/XT, or PC/AT also uses the DSP32 chip. The Thor array processor can do 32-bit floating-point arithmetic at 25 MHz and provide 12.5M flops. It has 64k bytes of static RAM with a 45-nsec access time. For developing DSP algorithms, a system-simulation software package, called Syssim, is standard. The Syssym package lets you plot results and zoom in on details of plots in the time and frequency domains. The package features windows, automatic scaling, and support for Hercules, CGA, and EGA graphics cards. In addition it includes a library of Turbo Pascal functions.

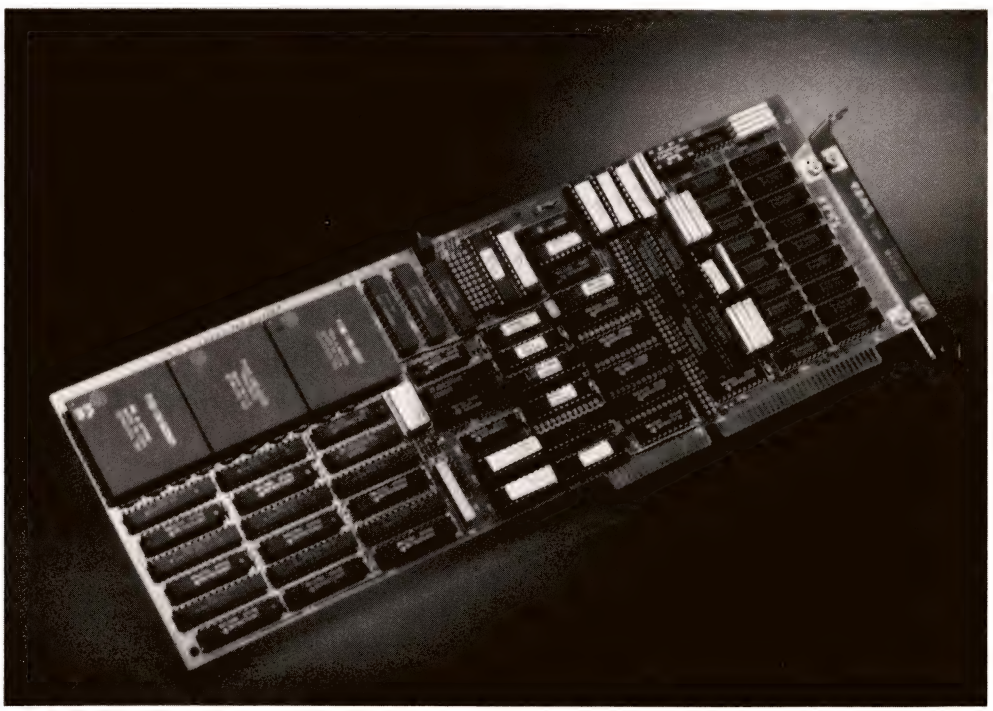
Getting around the 640k-byte barrier

If the direct-address limitation of MS-DOS is getting you down, Definicon System's DSI-785 coprocessor board overcomes the 640k-byte barrier. The board contains Motorola's 32-bit 68020 that runs at 16.67, 20, or 25 MHz. The CPU lets you directly address 1M, 4M, 8M, or 16M bytes of onboard memory. A 4-way interleave circuit lets you read or write to memory with zero or one wait state. It contains a 68881 floating-point unit and has a socket for an optional 68851 paged-memory unit. The board runs on the company's multitasking 32-bit operating system that supports files for MS-DOS, versions 2.x and 3.x. The board can access any adapter (or any other board) that is connected to the host-computer bus.

You can accelerate DEC computers too

Accelerator boards are available for DEC users whose programs take too long to run on the MicroVAX. An accelerator from CSP Inc, called the MAP-4000, provides 40M flops of single-precision and 20M flops of double-precision floating-point computations. It consists of a 3-board set with 13 VLSI chips. The set is available with 2M or 8M bytes of RAM; the latter is expandable to 256M bytes. It can do 32-bit multiplication and addition in 50 nsec and 64-bit multiplication and addition in 100 nsec. It can also do integer, byte, and bit manipulation at rates to 40 MOPS. An optimizing Fortran compiler, called Mapfort, vectorizes standard DO loops.

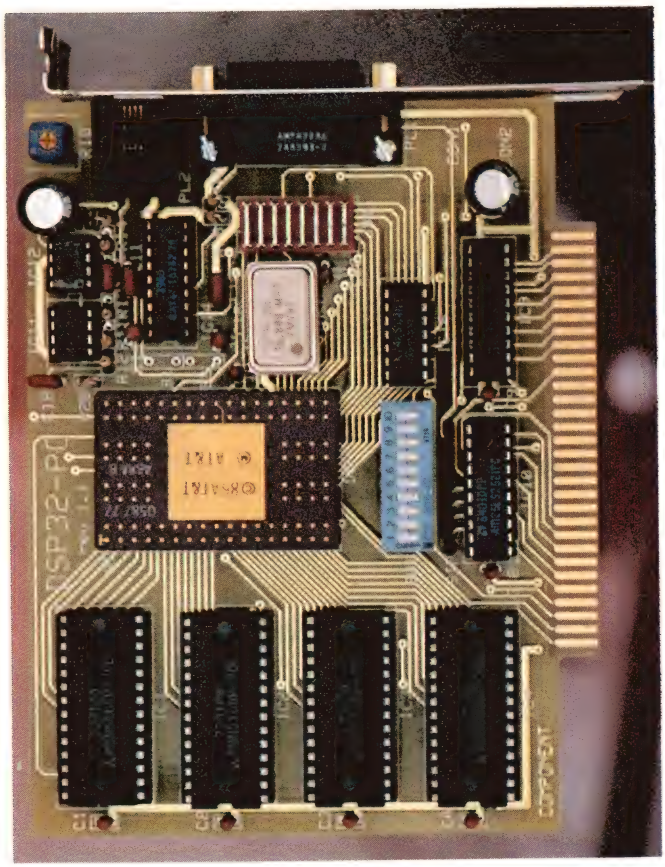
For those who need lots of array computations, the MicroMSP-4 from Computer Design & Applications performs high-speed array processing on the LSI-11 and MicroVAX computers. It consists of a vector pro-



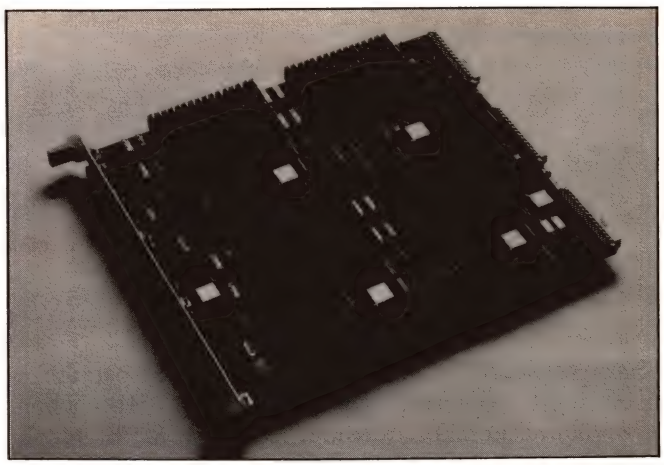
A 10-MIPS, 20M-flops board that accelerates C and Fortran programs on the IBM PC or PC/AT *(Mercury Computer Systems)*

cessor, a control processor, shared multiport memory, and a Q22 Bus host interface. The floating-point-math section of the vector processor is a VLSI device that can do 32-bit multiply, add, and subtract operations in 100 nsec. The 20M-flop vector processor has two 8k×32-bit static RAMs with 100-nsec access times for vector memory. The control processor is based on a 20-MHz 68020, which performs block-data movements and controls the overall processing.

The standard configuration for the MicroMSP-4 has 256k bytes (expandable to 2 or 4M bytes) of RAM that is dual ported to the control and vector processors. An additional 256k bytes of RAM is dual ported to the control processor and the host interface. The host interface lets the host read a block of control registers and supports block DMA transfers. Its VRTX real-time operating system, embedded in the control processor, coordinates any concurrent processing by multiple host users.



A 16-MHz accelerator board for developing DSP algorithms on an IBM PC *(Communication Automation & Control)*



A parallel-processing board for Sun workstations *(Topologix)*

Sky Computer's Vortex-vpa board increases the power of the Sun 3 family of workstations. This 9U-size VME bus board is a coprocessor for high-speed scalar and vector operations. Its arithmetic logic unit (ALU), which is based on Analog Device's ADSP3210 and ADSP3220 chips, can deliver 20 MIPS in integer mode and 20M flops (single-precision) in floating-point mode. The ALU can complete a 32- or 64-bit add, subtract, multiply, or logic operation in 100 nsec. The board contains 64-bit data paths that connect the ALU, a control processor, 16k×64 bits of program memory, as much as 16M bytes of data memory, and a VME Bus host interface. Both the host and the board's processors have access to the data memory. You can connect as many as four boards into one system.

An optional Fortran vectorizer, called the Vex-vpaf77 preprocessor, reads Fortran source code and translates it into an output file for use by the board. The preprocessor then automatically breaks the program down into vectors that take advantage of the board's vector and matrix processing speeds. The vectorized Fortran source file can process 1000 Daxpy elements at 6.5M flops, 1000 Saxpy elements at 11.7M flops, and a 1000-element single-precision dot product at 17.5M flops. The preprocessor also automatically translates arithmetic and logical operations into equivalent instructions that drive the board.

Parallel processing breaks up bottlenecks

You may have already filled your computer with a high-powered accelerator board and find you still have bottlenecks because of either your coprocessor's speed or the limited bus bandwidth of your host computer. Perhaps you think you need to buy a new computer. But don't give up yet. There still may be another way out. In some cases, parallel processing is becoming a viable alternative.

A number of manufacturers offer add-in processor boards with Transputers from Inmos as coprocessors. Although these boards are sold primarily as Transputer evaluation boards or development boards, you can use them as independent, powerful 32-bit processors. Most of the Transputer boards contain either a T414 or a

If you wish that your computer could tackle digital signal processing or image processing tasks, a plug-in array μP board can help.

T800 Transputer. These Transputers each contain a 32-bit RISC processor that performs 10 MIPS when operating at 20 MHz; they also have internal timers; a memory interface that can address 4G bytes of space, and four 10M-bps bidirectional serial communication links with a hardware scheduler for running concurrent programs. The T414 contains 2k bytes of RAM; the T800, 4k bytes. In addition, the T800 contains a 64-bit floating-point-math unit that can deliver 1.5M flops (single precision) when operating at 20 MHz.

A variety of Transputer boards make parallel operations possible for different configurations, ranging from single nodes to n-dimensional hypercubes. The IMSB008 from Inmos, for example, is a plug-in board for the IBM PC, PC/XT, PC/AT, and compatibles that acts as a motherboard for as many as eight Transputer modules (Trams). Each Tram contains either a T414 or T800 Transputer; external RAM size ranges from 32k to 8M bytes per Transputer. The serial links from each Tram connect to a 32-position crossbar switch (IMSC004) on the mother board. A 16-bit T212 Transputer uses software to make the crossbar switch connections and manages the communications over the computer bus.

The Quadputer from Microway is a plug-in board for the IBM PC, PC/XT, and 80386 computers. This board

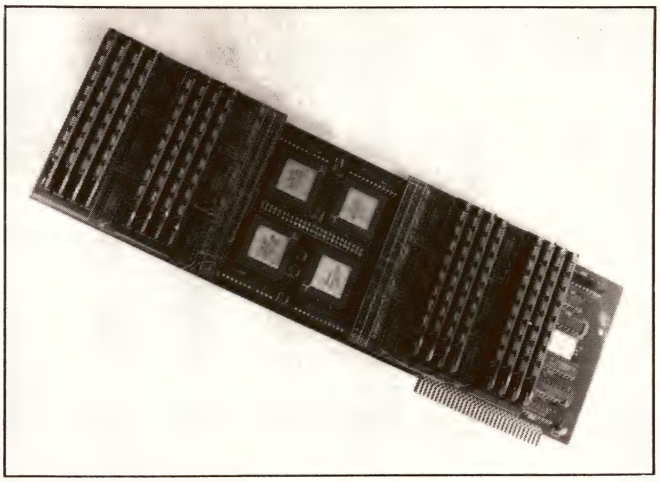
TABLE 1—REPRESENTATIVE ADD-IN μP BOARDS

COMPANY NAME	BOARD NAMES	COMPATIBLE COMPUTERS	CPUs	SPEED	CO-PROCESSOR	RAM	CACHE	OPERATING SYSTEM	SOFTWARE TOOLS
CAPLIN CYBERNETICS	QT SERIES	MICRO-VAX	T414 OR T800	17.5–35 MHz	NA	NA	2k OR 4k BYTES/ TRANS-PUTER	VMS, HELIOS	VMS DEVICE DRIVER; OCCAM, FORTRAN, C, COMPILERS
CAUSAL SYSTEMS	THOR	IBM PC, PC/XT, PC/AT	DSP32	25 MHz	NA	64k BYTES (DUAL-PORTED)	NA	MS-DOS	TURBO PASCAL, 3.0 AND 4.0 LIBRARIES; SYSSIM DSP DEVELOPMENT TOOL
COMMUNICATIONS AUTOMATION AND CONTROL	DSP32-PC	IBM PC, PC/XT, PC/AT	DSP32	16 MHz	NA	128k BYTES	NA	MS-DOS	C-COMPILER, ASSEMBLER, SIMULATOR, MATH LIBRARY, EMULATOR
COMPUTER DESIGN AND APPLICATIONS	MICRO MSP-4	MICRO-VAX	68020	20 MHz	VECTOR PROCESSOR (PROPRIETARY)	256k TO 4M BYTES (DUAL PORTED)	NA	VMS, VRTX	C AND FORTRAN COMPILERS
COMPUTER SYSTEM ARCHITECTS	PART .4, PART .5	IBM PC/AT AND 80386 μP	T800	20 MHz	NA	1M TO 8M BYTES	NA	MS-DOS	C, PASCAL, FORTRAN, AND OCCAM COMPILER
	PART .1, PART .6	IBM PC/AT AND 80386 μP	T800	20 MHz	NA	1M TO 4M BYTES	NA	MS-DOS	C, PASCAL, FORTRAN, AND OCCAM COMPILERS
	PART .2	IBM PC/AT AND 80386 μP	T414 AND T800	20 MHz	NA	256k BYTES	NA	MS-DOS	C, PASCAL, FORTRAN, AND OCCAM COMPILERS
CSP INC	MAP-4000 (3 BOARDS)	MICRO-VAX	VLSI PROCES-SOR	40 MHz	VSLI CO-PROCESSOR	2M TO 256M BYTES; 64k BYTES (LOCAL DATA)	32k BYTE (PROGRAM)	VMS	FORTRAN DEBUGGER AND COMPILER; REAL-TIME EXECUTIVE; MAP FORT
DEFINICON SYSTEMS	DSI-T4	IBM PC, PC/XT, PC/AT	T414 AND T800	20 MHz	NA	TO 4M BYTES	NA	CUBIX, HELIOS	OCCAM, C, FORTRAN COMPILERS
	DSI-785	IBM PC, PC/XT, PC/AT	68020	25 MHz	68881, 68882	TO 16M BYTES	NA	32-BIT MS-DOS	C, PASCAL, FORTRAN, BASIC COMPILERS
INMOS	IM5B008	IBM PC, PC/XT, PC/AT	T414 OR T800	20 MHz	NA	TO 8M BYTES/ MODULE	NA	MS-DOS	TRANSPUTER DEVELOPMENT SYSTEM; C AND FORTRAN COMPILERS
LEVCO	TRANS-LINK	MACINTOSH SE AND II	T414 AND T800	20 MHz	NA	1M TO 4M BYTES/ SECTION	NA	MACINTOSH PROGRAMMERS WORKSHOP	OCCAM AND C COMPILERS; ASSEMBLER

NOTES:
1. SP = SINGLE PRECISION.
2. DP = DOUBLE PRECISION.

has a different arrangement for interconnecting Transputers: It has sockets for one to four T414 or T800 Transputers. You can plug two memory modules into the board; each module serves two Transputers, for a total of four Transputers that can have as much as 4M bytes of external memory per Transputer. The serial links from each of the Transputers and a buffered link from the computer bus connect to a link connector located in the center of the board. To hook two Transputers together and link one of them through a link adapter to the PC bus, you install a personality module into the link connector.

The Megaframe/IBM is a link-adapter card from Parsytec that plugs into an IBM PC bus. It uses an Inmos C012 link-adapter chip to convert the 8-bit parallel data on the bus to a 10M- or 20M-bps serial data link. The serial link connects to a crossbar switch on the card that has 11 positions. Eight of the positions from the crossbar switch route to a connector in which you fit



An add-in processor board for the IBM PC, PC/XT, and 80386 computers *(Microway Inc)*

PERFORMANCE			POWER	PRICE	COMMENTS
MIPS	MFLOPS	BENCHMARKS			
60/NODE	9/NODE	24M WHETSTONES/SEC PER NODE (SP)[1]	15W	$7500	EDGE-CONNECTOR ACCESS TO TRANSPUTER LINKS
6.25	12.5	1024-POINT COMPLEX FFT IN <13 mSEC; FIR FILTERS WITH 160-nSEC TAPS	2.7W	$895 TO $995	NEURAL-NETWORK SUBROUTINE FOR PATTERN RECOGNITION
4	8	1024-POINT COMPLEX FFT IN 14 mSEC; FIR FILTERS WITH 250 nSEC TAPS; 3×3 MATRIX MULTIPLY IN 7 μSEC	2.5W	$745 (BOARD); $690 (SOFTWARE)	
—	20	1024-POINT COMPLEX FFT IN 4 mSEC; 512×512 POINT COMPLEX 2-D FFT IN 2.5 SEC. FIR FILTERS WITH 100-nSEC TAPS	50W (WITH 4M BYTES OF RAM)	$10,000	OPTIONAL SCSI PORT
10/NODE	1.0 (64 BITS) 1.5 (32 BITS) PER NODE	4M WHETSTONES/SEC PER NODE; 8634 DHRYSTONES/SEC PER NODE	12.5W PART .4; 22.5W PART .5	$1600 (1M BYTES)— $8000 (8M BYTES)	LINKS CONNECTED VIA JUMPER BLOCKS
10/NODE	1.0 (64 BITS) 1.5 (32 BITS) PER NODE	4M WHETSTONES/SEC PER NODE; 8634 DHRYSTONES/SEC PER NODE	12.5W PART .1; 15W PART .6	$4800 (FOUR T800 + 1M BYTES); $8800 (FOUR T800 + 4M BYTES)	LINKS CONNECTED VIA JUMPER BLOCKS
10/NODE	1.0 (64 BITS) 1.5 (32 BITS) PER NODE	4M WHETSTONES/SEC PER NODE; 8634 DHRYSTONES/SEC PER NODE	10W	$895 (T414) $1295 (T800)	PREWIRED LINKS; CAN BE CONNECTED VIA JUMPER BLOCKS; STARTER KIT AVAILABLE
—	40 (SP)[1] 20 (DP)[2]	40 MOPS; 32-BIT MULTIPLY IN 50 nSEC; 32-BIT DIVIDE IN 300 nSEC; 1024-POINT COMPLEX FFT IN 1.4 mSEC	—	$18,995 (2M BYTES); $22,500 (8M BYTES)	30M BYTES/SEC MAIN-MEMORY ACCESS; 80M BYTES/SEC LOCAL-MEMORY ACCESS
10/NODE	—	2.3M WHETSTONES/SEC PER NODE; 4500 DHRYSTONES/SEC PER NODE	—	$1490 (ONE T414 + 1M BYTES); $7490 (FOUR T800 + 8M BYTES)	LINKS CONNECTED VIA PROGRAMMABLE CROSSBAR SWITCH
4	—	1.2M WHETSTONES/SEC; 4600 DHRYSTONES/SEC	16W (16M BYTES)	$4990 TO $7490	TWO OPTIONAL SERIAL PORTS USING A 2681 DUART
10/NODE	1.5/NODE	4.6M WHETSTONES/SEC; 8285 DHRYSTONES/SEC	—	$1225 10-SITE MOTHERBOARD; $1505 (ONE T414 + 1M BYTE MODULE); $7471 (ONE T800 + 1M BYTE MODULE)	LINKS CONNECTED VIA PROGRAMMABLE CROSSBAR SWITCH
10/NODE	1.5/NODE	4.1M WHETSTONES/SEC PER NODE; 9600 DHRYSTONES/SEC PER NODE	—	$2397	NEURAL-NETWORK SIMULATOR SOFTWARE AVAILABLE FROM NEURONICS, INC, CAMBRIDGE, MA; STARTER KIT AVAILABLE

Table continued on pg 246

Accelerator boards are available for DEC users whose programs take too long to run on the MicroVAX.

TABLE 1—REPRESENTATIVE ADD-IN μP BOARDS *(Continued)*

COMPANY NAME	BOARD NAMES	COMPATIBLE COMPUTERS	CPUs	SPEED	CO-PROCESSOR	RAM	CACHE	OPERATING SYSTEM	SOFTWARE TOOLS
MERCURY COMPUTER SYSTEMS	MC3200AT	IBM PC/AT	WEITEK XL SERIES	10 MHz	NA	2M TO 10M BYTES	256k-BYTE INSTRUC-TIONS	MS-DOS, UNIX, AEGIS	C AND FORTRAN COM-PILER; CODE OPTIMIZER, DISSASSEMBLER
MICROWAY INC	QUAD-PUTER	IBM PC, PC/XT, PC/AT AND 80386 COMPUTERS	T414 AND T800	20 MHz	—	1M TO 4M BYTES/ SECTION	NA	MS-DOS	OCCAM, C, FORTRAN, PASCAL COMPILERS
	SUPER CACHE-286	IBM PC/XT AND 8088 COMPUTERS	80286	12 MHz	80287 (OPTIONAL)	NA	32k BYTES	MS-DOS	OCCAM, C, FORTRAN, AND PASCAL COM-PILERS; 8087 LIBRARIES
OPUS SYSTEMS	SERIES 200 PER-SONAL MAIN-FRAME	IBM PC/AT	NS32332	15 MHz	NS32081, NS32082	4M TO 16M BYTES	NA	UNIX V.3 MS-DOS	C, FORTRAN, COBOL, COMMON LISP, BASIC COMPILERS
	SERIES 300 PER-SONAL MAIN-FRAME	IBM PC/AT	CLIPPER C100	25 OR 30 MHz	CLIPPER FPU, MMU	4M TO 16M BYTES	8k BYTES	UNIX V.3 MS-DOS	C, FORTRAN, COBOL, COMMON LISP, BASIC COMPILERS
PARSYTEC	MEGA-FRAME/PC	IBM PC/AT	T414 OR T800	17–30 MHz	NA	1M BYTE/ TRANS-PUTER	NA	PC-DOS	MEGATOOL DEVELOP-MENT BOARD. C, PASCAL, FORTRAN, OCCAM COMPILERS
SKY COMPUTERS	VORTEX-VPA	SUN 3 WORK-STATION	NA	10 MHz	ADSP 3220	4M, 8M, OR 16M BYTES (DATA); 16k×64 BIT (PROGRAM)	NA	SUN UNIX	C AND FORTRAN COMPILERS; FORTRAN VETORIZER
	VORTEX-AT	IBM PC/AT	NA	10 MHz	ADSP 3210	1M OR 4M BYTES (DATA); 8k×64 BITS (PROGRAM)	NA	MS-DOS PC-DOS	MICROSOFT-C, MICRO-SOFT FORTRAN, RYAN McFARLAND FORTRAN, DIRECT-COMMAND INTERFACE LIBRARY
	WARRIOR-Q	MICRO-VAX II, 3500/3600 COMPUTERS	2901 (BIT-SLICE)	10 MHz	VLSI	2M OR 8M BYTES	64k OR 256k BYTES	VMS	FORTRAN-77, VAX C, VMS DEVICE DRIVER, ASSEMBLER DEBUGGER
	WARRIOR-S	SUN 3 WORK-STATION	2901 (BIT-SLICE)	10 MHz	VLSI	2M OR 4M BYTES	64k OR 256k BYTES	SUN UNIX	FORTRAN, C, ASSEMBLER, DEBUGGER, VECTOR SUBROUTINE LIBRARY
TOPOLOGIX	TOPOLOGY 1000	SUN 3 AND SUN 4 WORK-STATIONS	FOUR T800s	20 MHz	NA	4M BYTES/ NODE	1k BYTE/ NODE	SUN UNIX, TRILLIUM (SOON)	ANSI C, ANSI F77, COMMON LISP

NOTES:
1. SP = SINGLE PRECISION.
2. DP = DOUBLE PRECISION.

a module with two Transputers and 2M bytes of RAM per node. The remaining two positions fasten to back-panel connectors and in this way can connect to external systems located as far away as 10 meters.

The PART series from Computer System Architects consists of a number of plug-in boards for the IBM PC and PC/AT computers. They have a link adapter, Transputers, and RAM on a single card. You manually configure the links through jumper blocks located on the card.

All of these systems have compilers for Inmos's Occam parallel development language. To provide transportability to existing applications, most suppliers provide compilers for parallel versions of C, Pascal, and Fortran 77. These versions contain extra statements such as "PAR," which instructs the computer to run the succeeding statements in parallel, "SEND," which directs operations to a particular Transputer, and "GET," which retrieves data from a selected Transputer. The compilers have network loaders that synchro-

PERFORMANCE			POWER	PRICE	COMMENTS
MIPS	MFLOPS	BENCHMARKS			
10	20	7.1M WHETSTONES/SEC; 11k DHRYSTONES/SEC; FIR FILTER WITH 109 nSEC TAPS; 4×4 MATRIX MULTIPLY IN 6.5 μSEC; 1024-POINT COMPLEX FFT IN 3.2 mSEC	PC/AT BOARD WITH 2M BYTES, 15W	FROM $10,000	ENTIRE 10M BYTES OF MEMORY AVAILABLE TO AN IBM PC/AT COMPUTER VIA AN I/O INTERFACE
10/NODE	1.5/NODE	4.1M WHETSTONES/SEC PER NODE	—	$6000 (FOUR T414 + 4M BYTES)	LINKS CONNECTED VIA EXTERNAL CONNECTOR
1.431 USING A 12-MHz 80287	—	267.96 WHETSTONES/SEC USING A 12 MHz 80287; NORTON SI 8.2	—	$499; 80287 OPTION $450	SWITCHES FROM 80286 TO 8088 MODE WITHOUT REBOOT
2	0.3	2155 DHRYSTONES/SEC	30W (16M BYTE)	$3995 (4M); $6155 (8M); $9755 (16M)	REAL-TIME I/O EXECUTIVE; OPTIONAL SOFTWARE SUPPORTS ETHERNET CONTROLLER
4 (25 MHz); 5 (30 MHz)	1	7278 DHRYSTONES/SEC	27W (16M BYTE)	$6140 (25 MHz WITH 4M BYTES); $13,400 (30 MHz WITH 16M BYTES)	REAL-TIME I/O EXECUTIVE; OPTIONAL SOFTWARE SUPPORTS ETHERNET CONTROLLER
10/NODE	1.5/NODE	4M WHETSTONES/SEC PER NODES	25 MHz WITH 4M	$4850 (TWO T414); $5200 (TWO T800)	LINKS CONNECTED VIA PROGRAMMABLE CROSSBAR SWITCH
20	20 (SP)[1] 10 (DP)[2]	64-POINT COMPLEX FFT IN 0.25 mSEC; LINPACK (100×100 DP CODED BLAS) = Mflops	50W (4M BYTES)	$19,900 (4M BYTE)	APPEARS AS SMART MEMORY TO THE HOST
20	20 (SP)[1] 10 (DP)[2]	64-POINT COMPLEX FFT IN 0.25 mSEC; LINPACK (100×100 DP CODED BLAS) = 1.20M flops	22W (4M BYTES) 30 MHz WITH 16M	$9900 (1M BYTE)	
—	15 (SP)[1] 0.5 (DP)[2]	1024-POINT COMPLEX FFT IN 3.1 mSEC	50W (2 BOARDS)	$12,900	VSB AUXILIARY BUS
—	15 (SP)[1] 0.5 (DP)[2]	1024-POINT COMPLEX FFT IN 3.1 mSEC	50W	$11,900 TO $15,900	
10/NODE	1.0 (SP)[1] 1.5 (DP)[2] NODE	4M WHETSTONES/NODE	—	$24,000	LINKS CONNECTED VIA PROGRAMMABLE CROSSBAR SWITCH

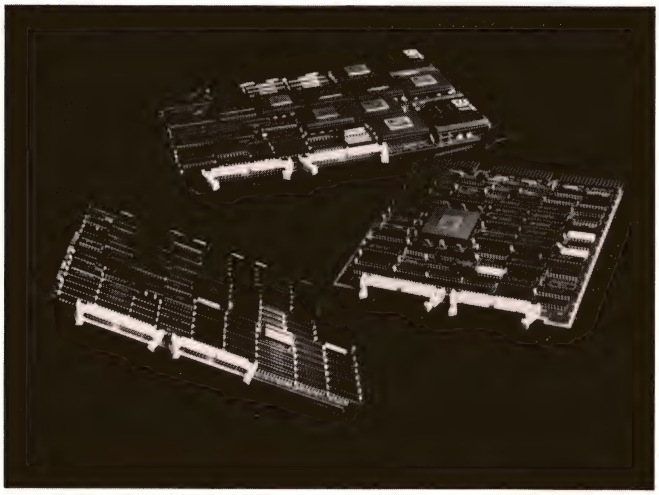
nize programs running on multiple Transputer nodes.

Levco's Translink cards brings parallel computing to Macintosh II and Macintosh SE users. The Translink II card is a single-slot Nubus card that can hold four Transputer modules and a programmable link switch. The Translink SE card is a single-slot SE bus card that holds one or two Transputer modules. The modules have four sockets that can carry 4M bytes of RAM. The cards' software development tools, which include a C compiler, run under the Macintosh Programmers Workshop (MPW).

You can equip a Sun 3 or 4 workstation for parallel processing also. The Topology 1000 from Topologix is a 9U-size VME Bus board for the Sun systems that includes 4 Transputers with 1M to 16M bytes of dynamic RAM per node, address- and data-bus interfaces with the host, a network controller (T212) that supports various network configurations, and a 32-position crossbar switch (C004) that connects to 16 off-board, full-duplex links. Since the board does not use shared

A number of manufacturers offer add-in processor boards with Transputers as coprocessors.

memory, you can use an unlimited number connected in node-to-node configurations. You can monitor the traffic on each link by designating each processor with an icon on the Sun screen. As individual CPU usage increases, the color of the icon changes from blue (quiescent) to red (active).



A 3-board set that performs 40M flops and 40 MOPS (CSP Inc)

In order to take advantage of parallel processing, you must be able to identify the places where bottlenecks arise in your software programs. You may, for example, find that your program is spending a great deal of time doing some nested DO loops before it can move on to other tasks. You may be able to run these loops in parallel with some other task. Keep in mind, however, that computing on parallel nodes requires communications between nodes. Although this communication occurs at 10M bps, you must still take this overhead time into account. So if you really want to take full advantage of a parallel operation, you have to be a little clever in recognizing your major bottlenecks when you transport your program to a parallel architecture. **EDN**

Article Interest Quotient (Circle One)
High 470 Medium 471 Low 472

For more information . . .

For more information on the add-in processor boards discussed in this article, contact the following manufacturers directly, circle the appropriate numbers on the Information Retrieval Service card, or use EDN's Express Request service.

Caplin Cybernetics Corp Ltd
Poplar Business Park, C25-27
10 Preston Road, London, UK E14 9RL
01-538-7630
Circle No 390

Causal Systems Inc
3716 S Hope St, Suite 300
Los Angeles, CA 90007
(213) 743-7208
Circle No 391

Communications Automation & Control
2348 Eden Lane
Bethlehem, PA 18018
(215) 865-9706
Circle No 392

Computer Design & Applications Inc
411 Waverly Oaks Rd
Waltham, MA 02154
(617) 647-1900
TLX 922521
Circle No 393

Computer System Architects
950 N University Ave
Provo, Utah 84604
(801) 374-2300
Circle No 394

CSP Inc
40 Linnell Circle
Billerica, MA 01821
(617) 272-6020
TWX 710-347-0176
Fax 617-663-0150
Circle No 395

Definicon System Inc
1100 Business Center Circle
Newbury Park, CA 91320
(805) 499-0652
Fax 805-498-3559
TLX 272849
Circle No 396

Inmos Corp
Box 16000
Colorado Springs, CO 80835
(303) 630-4000
TWX 910-920-4904
Circle No 397

Levco Corp
6160 Lusk Blvd, Suite C-100
San Diego, CA 92121
(619) 457-2011
Circle No 398

Mercury Computer Systems Inc
600 Suffolk St
Lowell, MA 01854
(617) 458-3100
Fax 617-458-9580
Circle No 399

Microway Inc
Box 79
Kingston, MA 02364
(617) 746-7341
TLX 503014
Fax 617-934-2414
Circle No 400

Opus Systems
20863 Stevens Creek Blvd, Bldg 400
Cupertino, CA 95014
(408) 446-2110
TLX 323114
Circle No 401

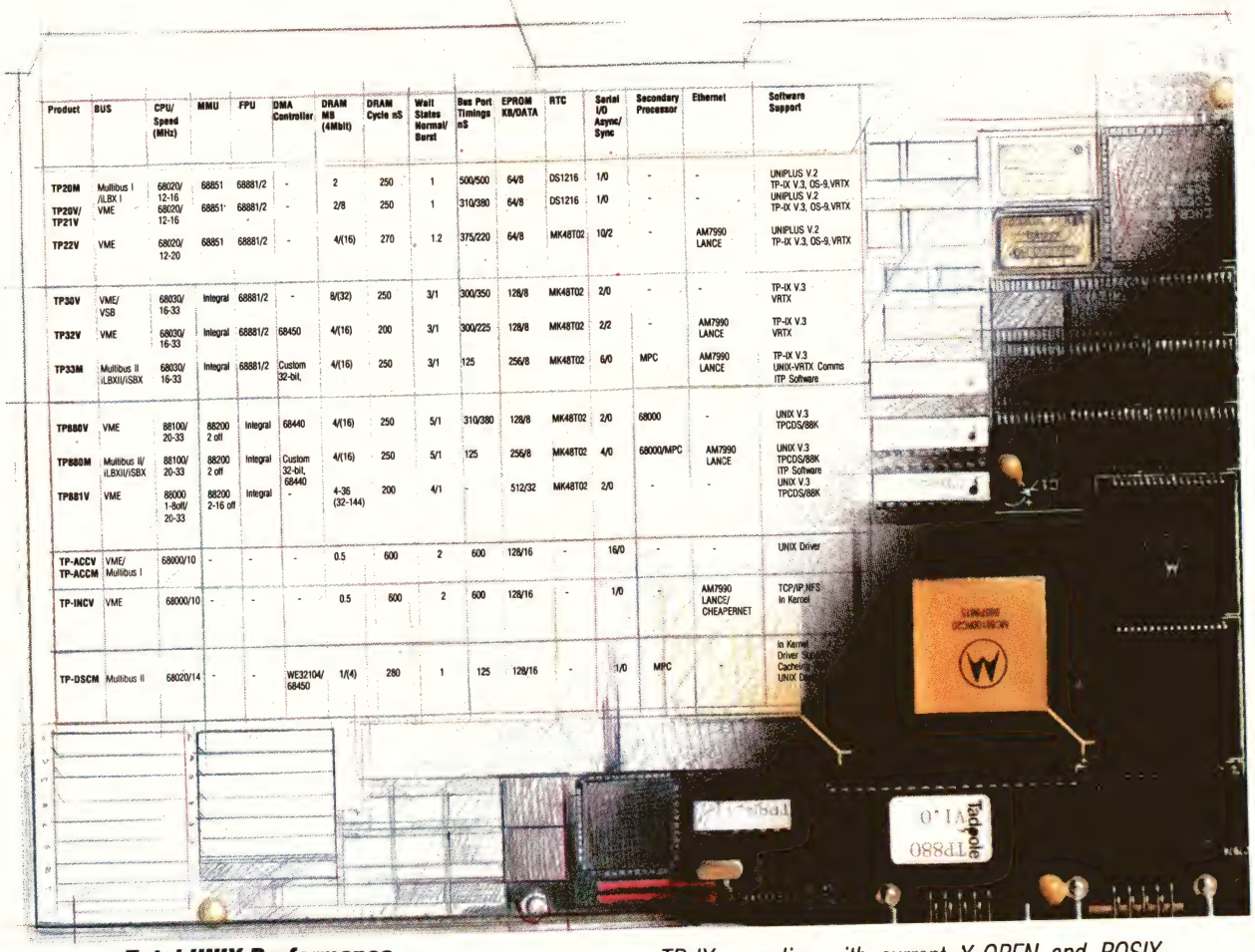
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Julicher Strasse
D-5100 Aachen, West Germany
(241) 1822275
TLX 8329659
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Sky Computers Inc
Foot of John St
Lowell, MA 01852
(508) 454-6200
Fax 617-459-9873
Circle No 403

Topologix Inc
4860 Ward Rd
Denver, CO 80033
(303) 421-7700
TLX 984304
Fax 303-425-0278
Circle No 404

the total UNIX® matrix

Product	BUS	CPU/ Speed (MHz)	MMU	FPU	DMA Controller	DRAM MB (4Mbit)	DRAM Cycle nS	Wait States Normal/ Burst	Bus Port Timings nS	EPROM KB/DATA	RTC	Serial I/O Async/ Sync	Secondary Processor	Ethernet	Software Support
TP20M	Multibus I /iLBX I	68020/ 12-16	68851	68881/2	-	2	250	1	500/500	64/8	DS1216	1/0	-	-	UNIPLUS V.2 TP-IX V.3, OS-9,VRTX
TP20V/ TP21V	VME	68020/ 12-16	68851	68881/2	-	2/8	250	1	310/380	64/8	DS1216	1/0	-	-	UNIPLUS V.2 TP-IX V.3, OS-9,VRTX
TP22V	VME	68020/ 12-20	68851	68881/2	-	4/(16)	270	1.2	375/220	64/8	MK48T02	10/2	-	AM7990 LANCE	UNIPLUS V.2 TP-IX V.3, OS-9, VRTX
TP30V	VME/ VSB	68030/ 16-33	Integral	68881/2	-	8/(32)	250	3/1	300/350	128/8	MK48T02	2/0	-	-	TP-IX V.3 VRTX
TP32V	VME	68030/ 16-33	Integral	68881/2	68450	4/(16)	200	3/1	300/225	128/8	MK48T02	2/2	-	AM7990 LANCE	TP-IX V.3 VRTX
TP33M	Multibus II iLBXII/iSBX	68030/ 16-33	Integral	68881/2	Custom 32-bit,	4/(16)	250	3/1	125	256/8	MK48T02	6/0	MPC	AM7990 LANCE	TP-IX V.3 UNIX-VRTX Comms ITP Software
TP880V	VME	88100/ 20-33	88200 2 off	Integral	68440	4/(16)	250	5/1	310/380	128/8	MK48T02	2/0	68000	-	UNIX V.3 TPCDS/88K
TP880M	Multibus II/ iLBXII/iSBX	88100/ 20-33	88200 2 off	Integral	Custom 32-bit, 68440	4/(16)	250	5/1	125	256/8	MK48T02	4/0	68000/MPC	AM7990 LANCE	UNIX V.3 TPCDS/88K ITP Software
TP881V	VME	88000 1-8off/ 20-33	88200 2-16 off	Integral	-	4-36 (32-144)	200	4/1	-	512/32	MK48T02	2/0	-	-	UNIX V.3 TPCDS/88K
TP-ACCV TP-ACCM	VME/ Multibus I	68000/10	-	-	-	0.5	600	2	600	128/16	-	16/0	-	-	UNIX Driver
TP-INCV	VME	68000/10	-	-	-	0.5	600	2	600	128/16	-	1/0	-	AM7990 LANCE/ CHEAPERNET	TCP/IP,NFS In Kernel
TP-DSCM	Multibus II	68020/14	-	-	WE32104/ 68450	1/(4)	280	1	125	128/16	-	1/0	MPC	-	In Kernel Driver Su... Caching... UNIX D...



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Total UNIX Responsibility

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- *TP-VX, UNIX-VRTX communications*
- *TBug, comprehensive debugger*
- *T-PROM, Tadpole's standard monitor*
- *Full device driver packages*

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Have a head start on RISC development with Tadpole's TP880V and TP-CDS. Written in C, TP-CDS has been developed for use exclusively with the Motorola 88000 family and is designed to fully utilise the advanced features of RISC architectures, incorporating recent developments in compiler optimisation algorithms and error detection. 68020 support and a RISC Fortran compiler will be available later this year.

Total UNIX Solutions

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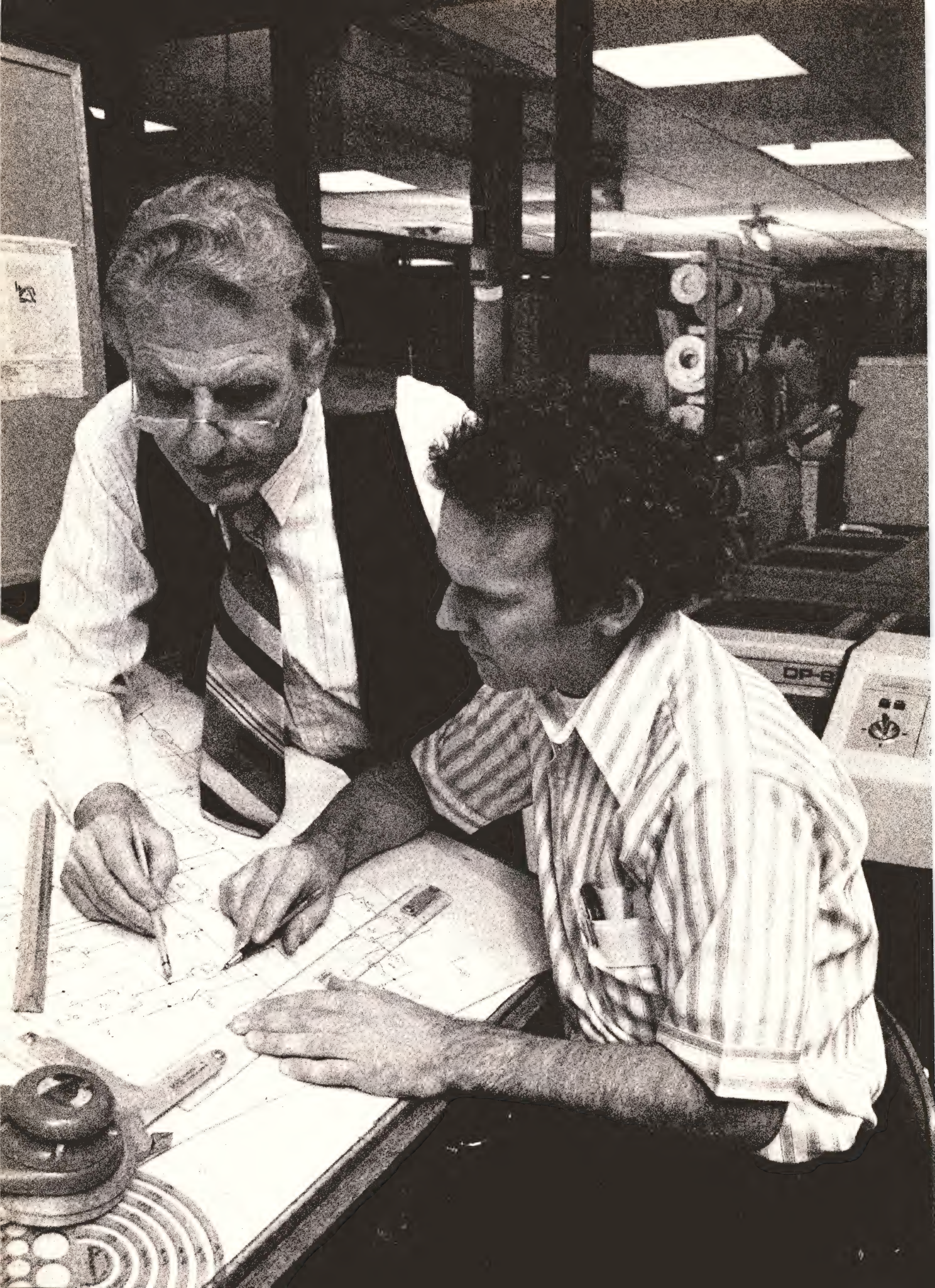
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Fax: 0101-617-890-7573

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Suite F, San Jose,
California 95131, U.S.A.
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T A D P O L E

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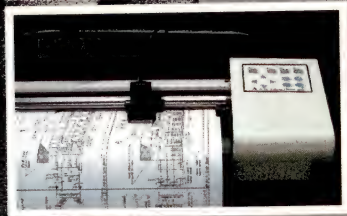
CIRCLE NO 175

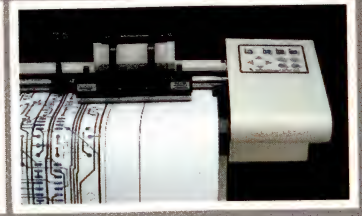


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PC MAGAZINE *Editor's Choice Dec. 22, 1987*

HI's commitment to solid, innovative products is underlined by designed–in versatility. The SCAN–CAD™ option lets a DMP–60 Series plotter double as a scanner. The Multi–Pen accessory speeds colorful, complex drawings. And HI's one megabyte buffer board lets the DMP–60 Series plot several originals—without tying up your computer.

Proven performance, proven value—that's HI plotters. Flexible. Fast. Accurate. Software compatible. Reliable. And backed by HI's PRIORITY RESPONSE™ customer support programs which include overnight product–replacement service, leasing, and warranty coverage.

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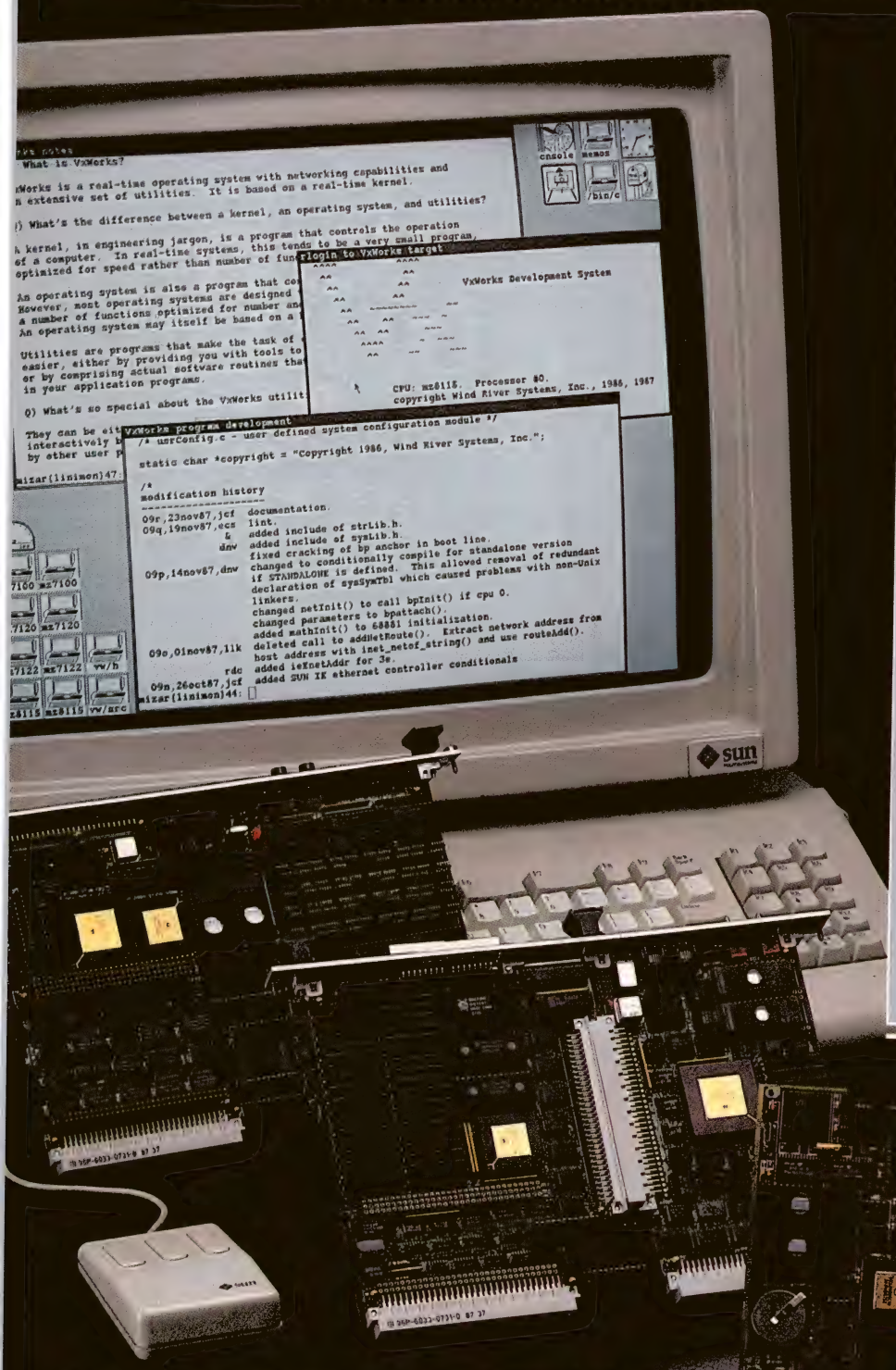
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CIRCLE NO 176

Easy targets.

Mizar opens new windows to real-time target development.



Application development made easy.
Mizar presents the perfect addition to a great line of real-time target processors: a great real-time development environment. First, choose from Mizar's array of real-time servers that include an enclosure fully integrated with VME processors, peripherals, and Wind River Systems' VxWorks™ Real-Time Operating System. Plug the server into your Sun network and you're ready to develop, download, and test your application code.

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Fully configured solutions.
Best of all, you don't have to worry about putting the hardware together. Your server is delivered complete, configured, and ready for application development.

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CIRCLE NO 185

Pocket-size smart-card terminal offers voice and data communications

You no longer need a PC to program the vendor's 8-bit-μP-based Memocard smart cards: You can program them simply by plugging them into the pocket-size Multiportable terminal. The Multiportable unit functions as a computer with built-in word-processing and arithmetic functions, a numeric keypad, and a clock. You can plug an optional modem into the terminal for remote data communications.

Application programs load into the Multiportable terminal from the credit-card-size Memocard; the terminal runs the programs in much the same way that a desktop computer executes software from a floppy disk. The terminal reads program data from a Memocard or an external port and then executes the program from RAM. You can also use the terminal to store and retrieve data on a Memocard.

The Multiportable has a 2-line, 16-character LCD and a 66-character QWERTY keyboard. The 6½×3¾×1¼-in. terminal weighs 12 oz and contains a proprietary 8-bit μP, 32k bytes of RAM, 32k bytes of ROM, a Memocard port, an RS-232C port, a modem port, and an expansion port. The unit operates from a rechargeable 6V battery or from ac power.

Because both the Memocard and the Multiportable terminal are μP controlled, you can restrict access to the functions of either device via a security/encryption scheme. Furthermore, any attempt to remove the μP from a Memocard will result in the destruction of the μP. A single Multiportable terminal with a modem sells for $650. The price drops to $455 when you order at least 25 terminals. A single 2k-byte Memocard sells for $79; an 8k-byte Memocard costs $139.

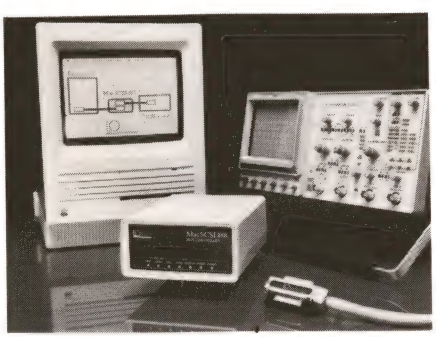
Multimil Inc, 670 International Parkway, Suite 190, Richardson, TX 75081. Phone (214) 644-7724. TLX 286258.

Circle No 442

IEEE-488 interface for Macintosh transfers 800k bytes/sec

The MacSCSI 488 interface, which provides transparent data translation for as many as 14 IEEE-488 instruments and peripherals, plugs into the SCSI port of a Mac Plus, Mac SE, or Mac II to facilitate data transfers of 600k bytes/sec (Mac Plus and Mac SE) or 800k bytes/sec (Mac II). The modem-size, standalone MacSCSI 488 conserves the Macintosh's expansion slots and doesn't require disassembly of the computer for installation.

The unit achieves its data-transfer speeds by acting as a pipeline between the host computer and your SCSI instrument, translating protocols via the MacSCSI 488's internal μC during transmission. Other SCSI controllers for the Macintosh



translate instrumentation data into Forth, thus adding an interpretation step before conversion.

The MacSCSI 488 doesn't interfere with operation of any external hard-disk drives controlled via your Macintosh's SCSI port. The unit comes with software device drivers that let you program it in languages such as Microsoft Basic 3.0, Turbo Pascal, Lightspeed C, VIP, and Hypercard.

The unit includes a memory-resident desk-accessory program that makes IEEE programming a utility of your Macintosh's software system. The desk-accessory software lets you acquire and save data from an IEEE-488 instrument while running an application program on your host computer. The MacSCSI 488 sells for $795, including language drivers and desk-accessory software.

IOtech Inc, 23400 Aurora Rd, Cleveland, OH 44146. Phone (216) 439-4091. TWX 650-282-0864.

Circle No 444

Floating-point, array-processor boards add computational power to PCs

Based on AT&T's DSP32 chip, DSP32-PC add-in boards accelerate general-purpose math applications on IBM PCs and PC/ATs. An 8M-flop PC half-card version does a 1024-point complex FFT in 14 msec, an FIR filter at 250 nsec/tap, and a 3×3-matrix multiplication in 7 μsec; a 25M-flop PC/AT full-card version performs a 1024-point complex FFT in 3.25 msec, an FIR filter at 80 nsec/tap, and a 3×3-matrix multiplication in 2.2 μsec.

For computation-intensive applications, the DSP32-PC allows you to employ your PC to host your software. The board's analog and digital interfaces also permit practical applications such as process control and speech analysis. For example, the DSP32-PC's modular phone connector lets you record and store speech on a hard disk, and its 8-bit codec and filter provide D/A and A/D conversion for processing speech signals.

Software development tools for the DSP32-PC are available separately or as a complete development system comprising the array-processor board, an assembler, a window-based emulator, demonstration programs, and a library of optimized assembly-language applications. The library contains 57 math routines and a number of graphics, signal-processing, and image-processing routines.

The 25M-flop IBM PC/AT version, based on the 80-nsec CMOS DSP32C IC, includes a maximum of 256k bytes of static RAM. The vendor will begin shipping production quantities of the board in the fourth quarter. The 8M-flop, IBM PC version, based on the 250-nsec NMOS DSP32 IC, is available now and costs $695 with 32k bytes of zero-wait-state static RAM. The DSP32-PC's C compiler costs $1500. The development system costs $995 and includes the array-processor board, window-based emulator, assembler, demonstration programs, and applications library.

Communications Automation & Control, 2348 Eden Lane, Bethlehem, PA 18018. Phone (215) 865-9706.

Circle No 445

High-capacity, flexible disk drive provides 24M-byte storage capacity

The Hyperflex flexible disk drive features a 24M-byte (unformatted) storage capacity. Combining the technologies of Winchester disk drives and standard floppy disk drives, the unit is suitable for IBM PC, PC/XT, PC/AT, PS/2 Model 30, PC-compatible, and Apple machines. You can mount the 5¼-in, half-height drive internally or use it externally as a subsystem. The 24M-byte drive can read its predecessor, a 12M-byte disk, facilitating upgrades.



Verbatim manufactures the Hyperflex disk, which has an outer shell similar to the type used in 3½-in. microdiskettes. This construction ensures a protected disk that needs no special handling. The disk uses a Barium ferrite media that provides a recording density of 24 kfci (thousand flux changes per inch). The disk drive's formatted capacity of 20M bytes is 55 times that of the industry-standard 360k-byte floppy disk drive.

The Hyperflex uses the contact technique found in traditional floppy disk drives and is immune to the head crashes common with hard disks. The disk's self-centering hub provides repeatable registration of better than 200 μin. A high-speed voice-coil actuator replaces the stepper motor that floppy disk drives use for head positioning, and the drive's embedded SCSI controller provides transparent defect mapping and error correction. OEM pricing for a 24M-byte model is less than $600.

Data Technology Corp, 2551 Walsh Ave, Santa Clara, CA 95051. Phone (408) 727-8899.

Circle No 446

Mainframe Power for your PC!

If you need or are accustomed to the throughput of a 32-bit mini, including any of DEC's VAX series, MicroWay has great news for you. The combination of our NDP compilers and our mW1167 numeric coprocessor gives your 386 PC, VAX speed! If you don't own a 386 PC, we provide a number of economical PC and AT upgrade paths.

Many of our NDP Fortran-386 users are reporting turn around times that are two to six times faster than their VAX. The exact times are a function of the VAX processor being used, the speed of the 386, the number of users being served by the VAX, and the coprocessor being used with the 386. There are currently over 400 developers using our NDP tools to port 32-bit applications. To help the 386/1167 engineering standard emerge, MicroWay is co-marketing several mainframe applications that have been ported by our customers. In addition, this ad introduces the first of many utilities that will ease the porting of your favorite in-house programs. These include tools like NDP-Plot, which provides CalComp compatible screen and printer graphics, and NDP Windows.

MicroWay has mW1167 boards in stock that run on the Compaq 386/20, IBM PS2/80, Tandy 4000, AT&T 6386, Acer 386/20, Everex Step 386/16(20), H.P. Vectra RS/16(20) and others. We now have a new board for the Compaq 386/20 which combines an 1167 with VGA support that is register compatible with IBM — the "SlotSaver". It features an extended 800x600 high res mode that is ideal for 386 workstations.

Finally, we still offer the 16-bit software and hardware which made us famous. If you own a PC or AT and are looking for the best 8087/80287 support on the market, call (508) 746-7341 and we'll send you our full catalog.

Dr. Robert Atwell, a leading defense scientist, calculates that NDP Fortran-386 is currently saving him $12,000 per month in rentals of VAX hardware and software while doubling his productivity!

Fred Ziegler of AspenTech in Cambridge, Mass. reports "I ported 900,000 lines of Fortran source in two weeks without a single problem!" AspenTech's Chemical Modeling System is in use on mainframes worldwide and is probably the largest application to ever run on an Intel processor.

Dr. Jerry Ginsberg of Georgia Tech reports "My problems run a factor of six faster using NDP Fortran-386 on an mW1167 equipped 386/20 than they do on my MicroVAX II."

32-Bit Compilers and Tools

NDP Fortran-386™ and **NDP C-386™** Compilers generate globally optimized mainframe quality code and run in 386 protected mode under PharLap extended MS-DOS, UNIX, or XENIX. The memory model employed uses 2 segments, each of which can be up to 4 gigabytes in length. They generate code for the 80287, 80387, or mW1167. Both compilers include high speed EGA graphics extensions written in C that perform BASIC-like screen operations ..... $595 each

- **NDP Fortran-386™** Full implementation of FORTRAN-77 with Berkeley 4.2, VAX/VMS and Fortran-66 extensions.
- **NDP C-386™** Full implementation of AT&T's PCC with Microsoft and ANSI extensions.

NDP Package Pricing:
387FastPAK-16: NDP Compiler, PharLap, and 80387-16 Coprocessor $1299
1167FastPAK-16: NDP Compiler, PharLap, and mW1167-16 Coprocessor $1695

NDP Windows™ — NDP Windows includes 80 functions that let you create, store, and recall menus and windows. It works with NDP C-386 and drives all the popular graphics adapters. Library ..... $125, C Source $250

NDP Plot™ — Calcomp compatible plot package that is callable from NDP Fortran. It includes drivers for the most popular plotters and printers and works with CGA, Hercules, EGA and VGA $325

NDP/FFT™ — Includes 40 fast running, hand coded algorithms for single and double dimensioned FFTs which take advantage of the 32-bit addressing of the 386 or your hard disk. Callable from NDP Fortran or NDP C with 1167 and 387 support $250
387FFT for 16-bit compilers $250

387BASIC™ — A 16-bit Microsoft compatible Basic Compiler that generates the smallest .EXE files and the fastest running numeric code on the market. $249

MicroWay® 80386 Support

Parallel Processing

Monoputer™
The world's most popular Transputer development product runs all MicroWay Transputer software using either a T414 or T800. The T800 processor has built-in numerics and provides performance comparable to an 80386 running at 20 MHz with an mW1167. The new 3L Parallel C and Fortran Compilers makes this an especially attractive porting environment. Can be upgraded to 2 megabytes.
Monoputer with T414 (0 MB) $995
Monoputer with T800 (0 MB) $1495

Quadputer™
This board for the XT, AT, or 386 can be purchased with 2, 3 or 4 Transputers and 1, 4 or 8 megabytes of memory per Transputer. Two or more Quadputers can be linked together to build networks with mainframe power which use up to 36 Transputers. One customer's real-time financial application has gone from 8 hours on a mainframe to 16 minutes on a system containing five Quadputers. ... from $3495

Transputer Compilers and Applications
MicroWay and 3L offer Parallel languages for the Monoputer and Quadputer.
MicroWay Parallel C $595
MicroWay Occam2 ..... $495
3L Parallel C $895
3L Parallel Fortran $895
µField — A specialty finite element analysis package targeted at Transputer networks. Ideally suited to take advantage of the 6 Megaflop speed of the Quadputer. $1600

Call (508) 746-7341 for our free catalog!

Numeric Coprocessors

mW1167™ — Built at MicroWay using Weitek components and an 80387 socket.
mW1167-16 ..... $995
mW1167-20 ..... $1595
mW1167/VGA-20 "SlotSaver" $1995
8087 ..... $99
8087-2 ..... $154
80287-8 ..... $239
80287-10 ..... $295
80387-16 ..... $475
80387-20 ..... $725
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DRAM ..... CALL
(All of our Intel coprocessors include 87Test.)

PC and AT Accelerators

MicroWay builds a number of 8086 and 80286-based PC accelerators that are backed up by the best customer support in the industry.
Number Smasher™ (8087 & 512K) .. $499
FastCACHE-286/9 MHz $299
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MicroWay's **AT4™**, **AT8™**, and **AT16™** are the fastest 80186-based intelligent serial controllers on the market. They come with drivers for UNIX, XENIX, and PC MOS.
AT4 ... $795 AT8 ... $995 AT16 ... $1295

32-Bit Applications

COSMOS-M/386 — SRAC's finite element package for the 80386 with an 80387 or mW1167 provides mainframe speed and capacity. Turn around times rival the VAX 8650 and are 6 to 15 times that of an AT: from $995

PSTAT-386 — This mainframe statistics package has been used by government and industry for 20 years. The full version was ported. Requires 4 to 6 megabytes of memory: $1495

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32 High St., Kingston-Upon-Thames, U.K., 01-541-5466
St. Leonards, NSW, Australia 02-439-8400

CIRCLE NO 178

Analog-signal multiplexer plugs into Macintosh II

The Amux-64 card provides analog-signal-multiplexing capability for the vendor's NB-MIO-16 multifunction data-acquisition card for the Apple Macintosh II. The multiplexer card resides in a card cage and connects via a cable to the data-acquisition card, which resides in the Macintosh II.

The multiplexer card provides 16 separate 4:1 analog-multiplexer circuits and can multiplex as many as 64 single-ended or 32 differential inputs. The NB-MIO-16 card provides 16 analog-input channels, a 12-bit A/D converter capable of rates as fast as 100k samples/sec, two multiplying 12-bit D/A converters, eight digital I/O lines and three independent 16-bit counter/timers. You can daisy-chain as many as four Amux-64 cards, thus allowing the NB-MIO-16 to measure as many as 256 single-ended analog inputs simultaneously.

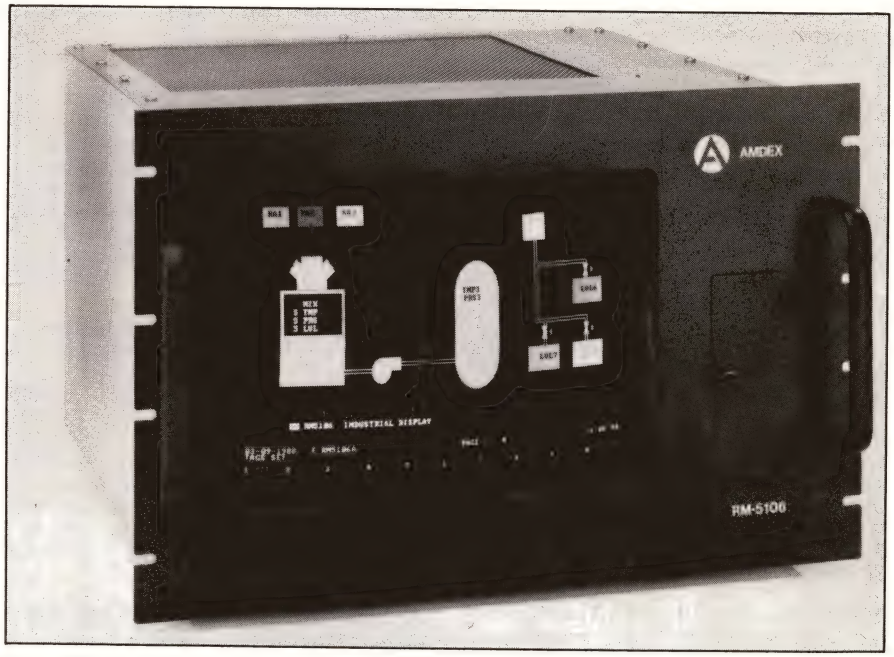
Each Amux-64 card has two 50-pin male DIN connectors for connecting ribbon cables. One cable connects directly to the I/O connector of the NB-MIO-16 card, which plugs into the chassis of the host computer. You can use the other connector to daisy-chain multiple Amux-64 cards. The Amux-64 sells for $695. Prices for the NB-MIO-16 vary from $1195 to $1495, depending on the A/D-converter speed.

National Instruments, 12109 Technology Blvd, Austin, TX 78727. Phone (800) 531-4742; in TX, (800) 433-3488. TLX 756737.

Circle No 443

Rack-mounted high-resolution monitor supports VGA video standard

According to its manufacturer, the RM-5106 Multi/Res display is the only industrial display available in rack-mount and NEMA styles that conforms to the new VGA video standard. The RM-5106 has a 14-in. diagonal format and supports PGA, EGA, and CGA standards as well as the VGA standard. When operating with the Amdex VGA video adapter, it displays 64 colors with 800×600-pixel resolution (TTL mode) or 256 colors from a palette of 256,000 (analog mode).



The rack-mounted monitor has a NEMA-12 rating. It fits in a standard EIA 19-in. rack and requires 12.25 in. of panel height and 16 in. of rack depth. A gasketed access door covers the contrast, brightness, and power controls. An IEC power connector, a DB-9 signal-input connector, and a fuse holder are located at the rear of the monitor.

The RM-5106 display has a dot pitch of 0.31 mm and a bandwidth of 30 MHz. The monitor accommodates horizontal scan frequencies of 15 to 35 kHz and vertical scan frequencies of 60 to 90 Hz. Automatic synchronization is in accordance with the appropriate video standard. The display consumes 80W and operates over a temperature range of 0 to 55°C. $1750.

Amdex Corp, 267 Boston Rd, North Billerica, MA 01862. Phone (617) 663-2070.

Circle No 447

What 202 tiny shock absorbers do to "keyboard clatter"— and "keyboard feel"



Question: What kind of person would build two tiny shock absorbers into every key of a new tactile keyboard? Answer: The same person who replaced the mechanical switch other keyboard makers use with an entirely new design — to prevent noise and vibration every time a key is pressed.

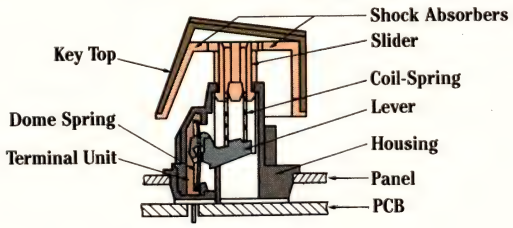
And what does this kind of perfectionism get you? A remarkably quiet tactile mechanical keyboard that's extremely reliable: up to 30 million keystrokes per key.

But to understand the best thing about Fujitsu's new FKB1000 Series keyboards, just type on them. The keyboard feel is crisp and positive, with a distinct 15g tactile return. And no clicky, clacky keyboard clatter.

When you want a keyboard for your next PC or terminal, remember Fujitsu's little shock absorbers. Your customers can't see them (and they certainly can't hear them). But they'll know they're there by the way they feel.

And so will you.

101-key (U.S.) and 102-key (European) keyboards available.



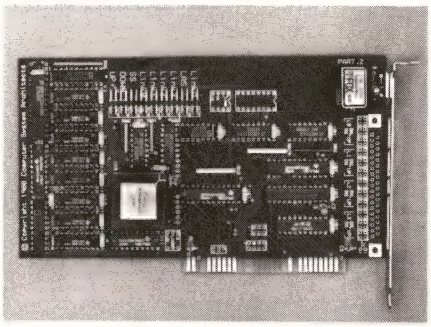
FKB1000 Series Keyboards

FUJITSU MIKROELEKTRONIK GmbH:
Arabella Center 9. OG./A, Lyoner Straße 44-48, D-6000 Frankfurt am Main 71, F.R. Germany Phone: 069-66320 Telex: 0411963 Fax: 069-6632122
FUJITSU COMPONENT OF AMERICA, INC.:
3330 Scott Blvd., Santa Clara, California 95054-3197, U.S.A. Phone: 408-562-1000 Telex: 910-338-0190 Fax: 408-727-0355
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Telex: 2224361 Fax: (03) 216-9771

FUJITSU

Add-in board includes a transputer and a DMA link to IBM PC bus

The Part.2 add-in board features an Inmos 32-bit T414-15 transputer, a DMA PC interface, four transputer links, and 256k bytes of dynamic RAM. It also includes Logical Systems' C compiler, assembler, and network loader. The link to the PC interface incorporates an 8-bit parallel DMA circuit on the PC side; interrupt control is optional.



You can use a single Part.2 board for transputer evaluation, for parallel-processor program development (using the C language), or as an accelerator for PC end-user applications. You can also use additional Part.2 boards as part of an array of parallel processors for experimentation or application acceleration.

All four pairs of bidirectional transputer links, plus the single pair of links from the link adapter, are brought out to connector pins on the upper edge of the pc board to facilitate connection to other transputer products. The board plugs into an IBM PC, PC/XT, or PC/AT slot. The transputer in the Part.2 board can act as a master to other processors. The Part.2 sells for $859.

Computer System Architects, 950 N University Ave, Provo, UT 84604. Phone (801) 374-2300.

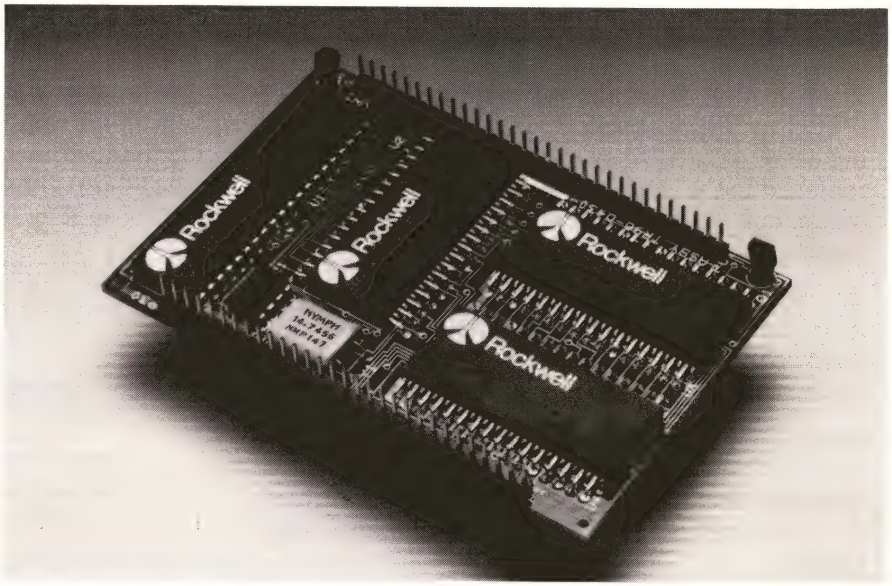
Circle No 448

Compact, low-power modem supports full-duplex, 9600-bps data transfers

Consuming less than 4W (typ), the R96QT compact modem provides both synchronous and asynchronous operation. It supports various dial-up modes, including an advanced fast-training mode (23 msec) for pseudo full-duplex, 9600-bps data transfers over the Public Switched Telephone Network.

The modem is compatible with CCITT V.29, V.22 bis, and V.22 A/B standards as well as Bell 212A and 103. The R96QT's operating speeds include the following: 300 bps in Bell 103 full-duplex asynchronous mode; 1200 bps in V.22 and Bell 212A asynchronous mode; 2400 bps in V.22 bis full-duplex asynchronous and synchronous modes; 9600 bps in V.29 half-duplex synchronous mode; and 9600 bps pseudo full-duplex synchronous mode using the company's Quick-Turn algorithm.

The R96QT module measures about 2.5×4 in. It includes dual-tone generation for DTMF dialing, a parallel μP bus interface, a CCITT V.24/RS-232C port, a dynamic receive range of −43 dBm, and TTL/CMOS compatibility. Amplitude-adaptive equalization automatically compensates for line distortion. The R96QT costs $110 (1000) and comes with a 5-year warranty.



Rockwell International, Semiconductor Products Div, Box C, Newport Beach, CA 92658. Phone (714) 833-4700.

Circle No 449

NOW SERVING 68030 EMULATION

MicroCASE supports the 68030 with 25 MHz emulation.



Step right up to the MicroCASE 68030 PROBE™ In-Circuit Emulator. The first, the fastest, the best 68030 support of its kind.

The 68030 PROBE incorporates the same unique features as our highly successful 68020 PROBE™ —the debugging tool chosen by hardware and software engineers in a wide variety of leading high technology equipment manufacturers world-wide.

Pre-fetch pipeline dequeueing

The 68030 PROBE provides in-circuit emulation— at speeds up to 25 MHz. PROBE also features pre-fetch pipeline dequeueing, so it's easy to figure out which instructions actually execute, and which bus cycles relate to those instructions.

And by merely changing the probe tip, the 68030 PROBE also supports the 68020.

True source-level debugging

The 68030 PROBE provides on-line debugging of high-level language software. Real source statements are displayed, eliminating lengthy translations from assembly language to your high-level language.

PROBE utilizes an IBM® PC AT as its instrumentation chassis, so you can get compiled code to its target via Ethernet, VAXNet, SUNNet, SCSI or RS-232. Whether you compile on a PC, a workstation or VAX,® MicroCASE supports more object code formats than any other vendor.



No need to wait any longer. Real-time emulation and dequeueing for the 68030 and 68020 are available now. From the number one supplier of hardware-assisted software debuggers for the 68000 series. The Atron Division of MicroCASE.

If you'd like more information, or a short product demonstration, call us today at **408-253-5933.** Or circle the number on the reader service card.

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MICRO CASE
ATRON DIVISION

Saratoga Office Center
12950 Saratoga Avenue
Saratoga, CA 95070
408-253-5933

In the United Kingdom, call Instrumatic U.K. Ltd. — (44) 62844426. In France, call Tekelec — (33) 145347535. In Germany, call Instrumatic Electronik — (49) 89858020.

Circle 181 for literature

Circle 182 for demonstration

Disk drives use fiber-optic link to communicate with CPU

The HP-FL fiber-optic link, intended for HP Precision Architecture systems, transmits data between a CPU and disk drives via light. The link provides cabling flexibility and supports large mass-storage configurations for the HP-3000 Series 900 and HP-9000 Series 800.

It consists of four components. The interface card resides in the CPU and provides an interface between the fiber-optic cable and the CPU's I/O backplane. The HP-27111A card fits the HP-3000; the HP-27115 card fits the HP-9000.

The second component, the HP-FL controller, is resident in the HP 7936FL and HP 7937FL disk drives and allows the drives to communicate with the CPUs. The disk drives' respective formatted capacities are 307M and 571M bytes. The average seek time is 20.5 msec, and the burst transfer rate is 5M bytes/sec.



The third component, the fiber-optic cable, runs between the CPU and the disk drives and provides communication over cable lengths to 500m. The fourth component is the PBus cable, a 64-pin cable that you can use to daisy chain as many as eight disk drives to provide access to the fiber-optic cable.

The HP-7936FL and HP-7937FL disk drives sell for $15,500 and $16,950, respectively. An upgrade kit to convert existing HP/XP-type disk drives to HP-FL types sells for $3315. The CPU interface cards cost $5800 and come with 30m fiber-optic cables.

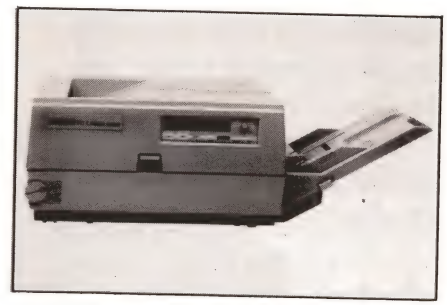
Hewlett Packard, 3000 Hanover St, Palo Alto, CA 94304. Phone local office.

Circle No 450

Laser printer works with IBM PCs and supports most software packages

The large memory capacity (1M bytes, expandable to 2M bytes) of the PC Laser 6000 printer makes it useful for printing complex graphics and spreadsheets as well as data-processing and word-processing applications. The printer suits IBM PCs, PC/ATs, PC/XTs, and compatibles, and prints six pages/minute.

The 6000's controller has its own graphics command set and includes Diablo 630 emulation. Optional emulation cards are available for the HP Laserjet Plus, IBM Proprinter, and Epson FX-80. Many software programs currently support the printer's controller; others will be available with the necessary drivers.



The Laser 6000 can download as many as 99 images, graphics, logos, and text selections, and it produces full-page, bit-mapped text and graphics at 300-dot/in. resolution. It supports 32 fonts per page, which you can select from the eight built-in fonts or optional font cartridges, or which can be downloaded from the host microcomputer. The printer also offers bold, shadow, underline, and compressed modes.

An adjustable 150-sheet paper tray accommodates letter-, legal-, and European-size sheets, as well as envelopes and transparencies. The PC Laser 6000 measures 8.1×16.1×16.5 in., and weighs approximately 37½ lbs. It costs $2495.

Ricoh Corp, 5 Dedrick Pl, West Caldwell, NJ 07006. Phone (201) 882-2000.

Circle No 452

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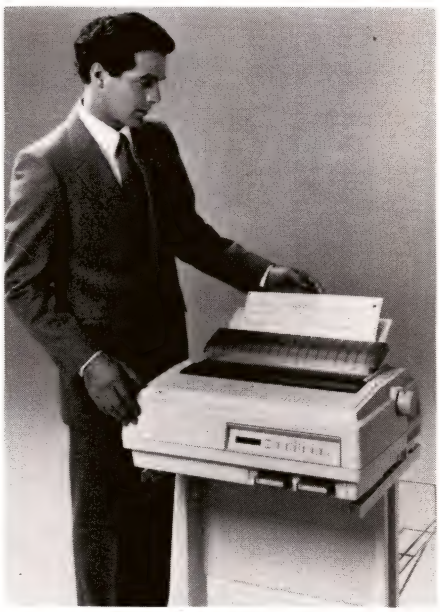
P.O. Box 1309
Round Rock, Texas 78680
512/244-3500 Telex 881906

CIRCLE NO 183

Line printer provides serial-matrix output for distributed-processing systems

Designed for use in distributed-processing-system environments, the 5512 serial-matrix printer uses a 24-wire, dual-column head to produce high-quality output in varied type sizes and styles. It prints bar codes and graphics as well. The printer's graphics resolution is 360×360 dots/in. At 12 cpi (characters per inch), the 5512 prints 160 cps in letter-quality mode, 320 cps in draft mode, and 480 cps in high-speed draft mode.

The printer includes dual 16-bit μPs. One controls the printing engine and printhead; the other controls the advanced formatting and system interfacing. The 5512 also includes RS-232C and current-loop serial interfaces, as well as a Centronics interface.



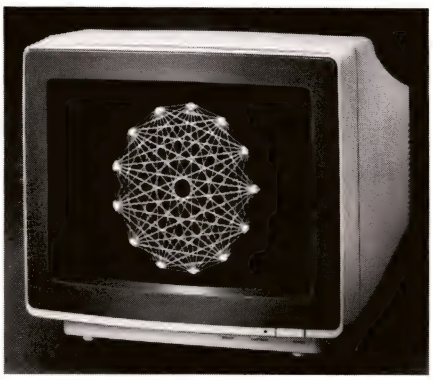
Standard fonts are Courier and Gothic. For letter-quality mode operation, you may choose Courier fonts in 5, 10, 12, 13.3, 15, 17.1 or 20 pitch. You can use Gothic fonts in draft mode with the same range of pitches. A single, 12-pitch Gothic font supports the high-speed draft mode. Two font-cartridge slots accept optional font cartridges. A 24-digit LCD indicates current font style and fault conditions. Pricing is $3495.

Tandem Computers, 1933 Vallco Parkway, Cupertino, CA 95014. Phone (408) 725-6000.

Circle No 451

Monitors with 720×540-pixel resolution interface with various PC color cards

Featuring a resolution of 720×540 pixels, the ECM 1300 Series of color monitors includes circuitry that automatically adjusts the operating frequency, allowing the monitors to interface to any PC with an add-in color card. The monitors easily move from one application to another, accommodating any PC graphics card with a frequency range of 15 to 34 kHz. The power supply can also adjust to any voltage from 90 to 240V.



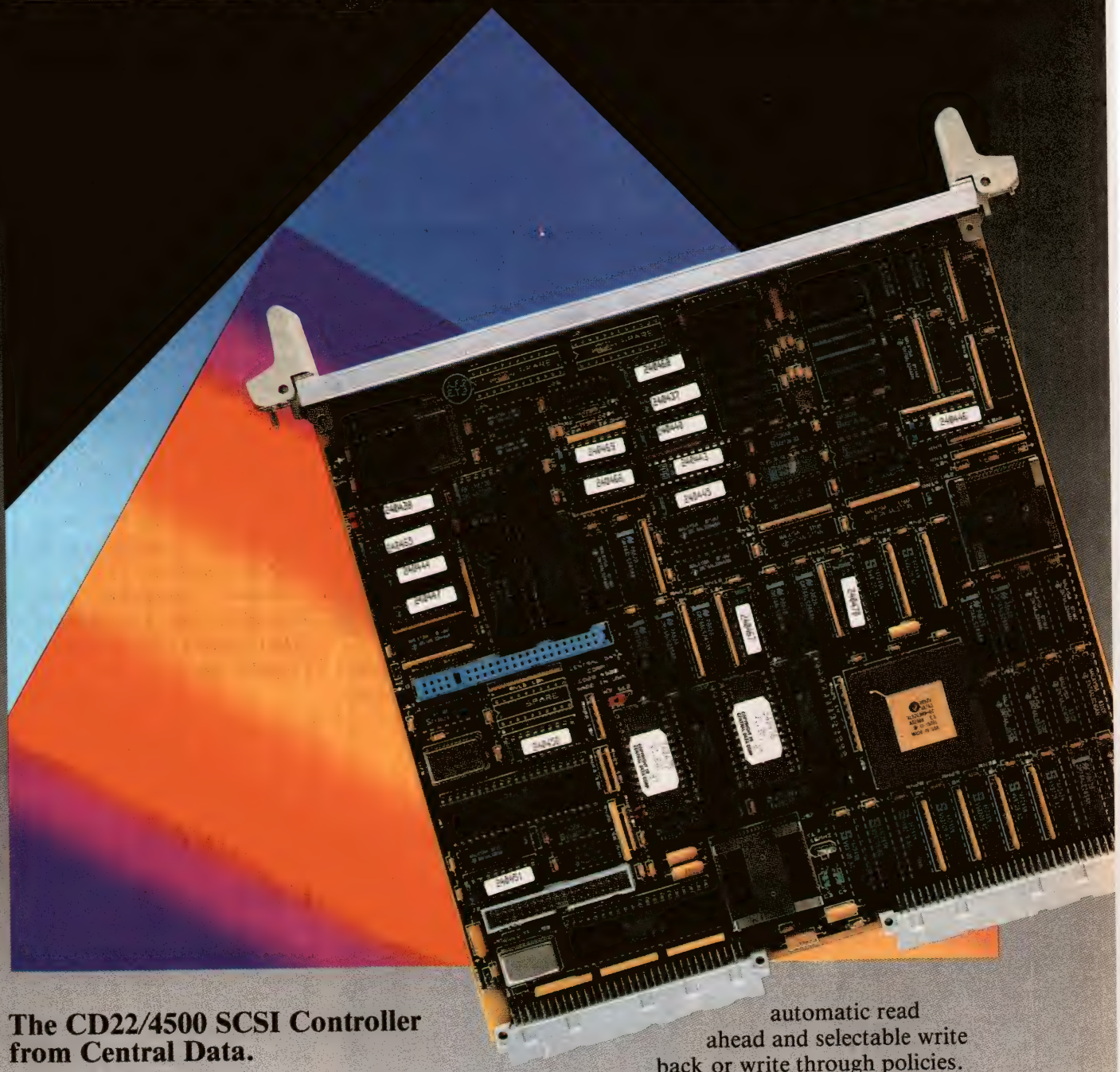
These features make the ECM 1300 Series suitable for CAD/CAM, business-graphics, and process-control applications that use add-in color cards. When connected to a PC running software such as Lotus 1-2-3 or Microsoft Windows, the monitors function as stand-alone graphics workstations.

You have a choice of three CRTs. The ECM 1310 is a short-persistence display with antiglare features. The ECM 1311 is a long-persistence, high-contrast monitor suitable for use in strong light. The ECM 1312 is the brightest of the three; it is a long-persistence phosphor monitor with a clear body. The monitors accept both RGB/RS-170 and IBM TTL inputs. Each costs approximately $1195.

Electrohome Ltd, 809 Wellington St N, Kitchener, Ontario, Canada N2G 4J6. Phone (519) 744-7111.

Circle No 453

Disk-Caching SCSI for Multibus* II.



The CD22/4500 SCSI Controller from Central Data.

Central Data is committed to a leadership role in the Multibus II market. With special emphasis on SCSI support.

The CD22/4500 provides the ultimate Multibus II SCSI solution. It's fast, transferring data at the limits of the SCSI bus. And versatile, providing either direct SCSI commands or Intel compatible PCI commands.

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Call product manager Andre Felix today for a detailed product brochure on the CD22/4500.

Central Data

1602 Newton Drive, Champaign, IL 61821-1098
1-800-482-0315
(In Illinois 217-359-8010)
FAX 217-359-6904

*Multibus is a trademark of Intel Corporation.

CIRCLE NO 184

Supercomputer with Prism architecture offers increased throughput

The Domain Series 10000 Personal Supercomputer is based on the Prism 64-bit architecture, which incorporates parallel-instruction single-cycle execution, multiprocessing capabilities. According to the company, in a single-processor configuration, the 10000 delivers 10 to 30 times the total throughput of a VAX 11/780; multiple-processor configurations deliver 60 to 100 times the throughput.



The 10000 contains separate 128k-byte instruction caches and 64k-byte data caches for each processor and features a 150M-byte/sec, 64-bit synchronous bus. Other features include shared virtual-memory processing, support for 128M bytes of main memory, and compatibility with IBM PC/AT and VME buses. It supports four 5¼-in. ESDI fast-actuator disk drives.

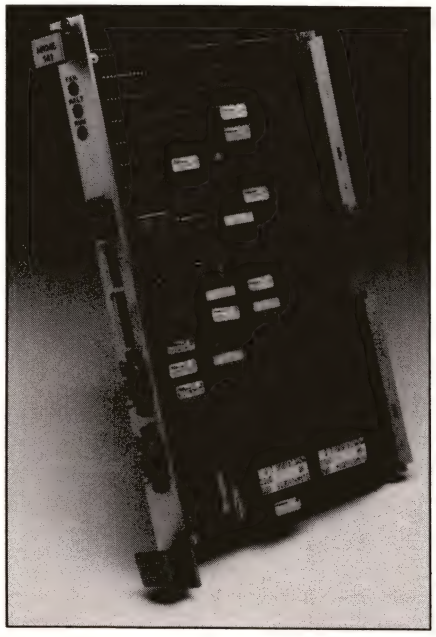
The computer is source-code and binary-data compatible with the company's entire product family, giving users access to a library of more than 1800 applications. An entry-level Series 10000 workstation includes 8M bytes of memory, a 348M-byte disk, eight planes of color, and a 19-in. 1024×800-pixel color display. Prices range from $79,900 (one processor) to $139,900 (four processors).

Apollo Computer Inc, 330 Billerica Rd, Chelmsford, MA 01824. Phone (617) 256-6600. TWX 710-343-C803.

Circle No 454

30-MHz CPU board provides enhanced access to memory and peripheral devices

The MVME141 CPU board uses a 68030 μP and a 68882 floating-point coprocessor to achieve operating speeds to 30 MHz. The board interfaces to the VSB (VME subsystem bus) and includes 64k bytes of 2-cycle physical cache and three ASICs to enhance the 68030's access to the system's memory and peripheral devices.



The μP includes an on-chip cache memory for both instruction and data, and has a Harvard-style parallel architecture. This construction provides two independent address buses and two independent 32-bit data buses, which enhances the μP's bandwidth and parallel operation.

The board uses custom ASICs to further enhance computing capability at the system level. One ASIC monitors the write activity on the VME Bus and ensures cache coherency, an important feature for multiprocessing applications. The second ASIC, the MVSB2400, provides a secondary bus interface and ensures rapid cache accesses. The third ASIC is the MVME6000 gate array, which provides local and VME Bus timing, and interrupt handling, and directly drives many of the VME Bus control signals. A 25-MHz version of the MVME141 costs $4122 (100).

Motorola, Microcomputer Div, Dept DW283, 2900 S Diablo Way, Tempe, AZ 85282. Phone (800) 556-1234; in CA, (800) 441-2345.

Circle No 456

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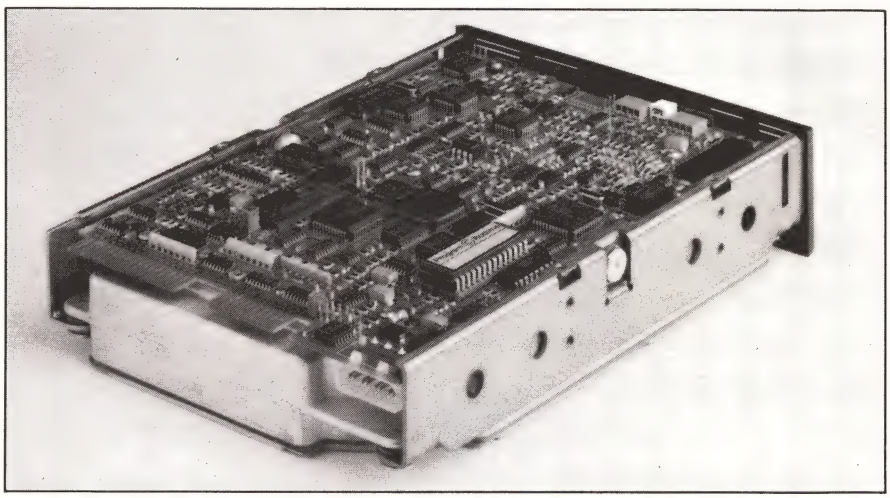
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CIRCLE NO 177

5¼-in. Winchester disk drives feature high capacity and ESDI interface

Already offering an embedded SCSI controller or an ST-506/412 interface, RO 5000 Series Winchester disk drives are now available with an ESDI interface. With the ESDI interface, users can design their own controllers or use off-the-shelf controllers.



The RO 5125 E and RO 5180 E have unformatted capacities of 127M and 178M bytes, respectively. The data-transfer rate is 1.25M bytes/sec, the average seek time is 22 msec, and the track-to-track seek time is 4 msec. Both drives use the RLL (2,7) recording method.

The RO 5125 E has three disks (six heads) and a formatted capacity of 106.5M bytes. The RO 5180 E has four disks (eight heads) and a formatted capacity of 149.1M bytes. OEM pricing is $1100 for the RO-5125-E, $1300 for the RO-5180-E.

Rodime Inc, Peripheral Systems Div, 29525 Chagrin Blvd, Pepper Pike, OH 44122. Phone (216) 765-8414.

Circle No 455

Transputer-based computers are easily expandable, perform 144M flops

The computing power of Megaframe Supercluster Series computers is expandable to meet the requirements of your application. The basic Model 64 contains a configurable array of 64 IMS-T800 or IMS-T801 transputers and 256M bytes of memory. When equipped with -T800 transputers, Model 64 is capable of performing 640 MIPS and 96M flops (scalar). When fitted with -T801 transputers, the computer performs 960 MIPS and 144M flops. To increase computing power still further, you can link several units together so that they appear as one transputer array.



Each basic unit also includes a system services unit that provides 6M-byte/sec effective I/O to disk-storage devices. You can connect as many as 16 standard workstations to each basic Supercluster computer. Via the workstation, you can request system resources that include part or all of the transputer array. The operating-system software that comes with the computer manages the allocation of these resources between users.

The Model-64 Supercluster computer is housed in a 19-in. rack cabinet that stands 50 in. high. It has a power-consumption rating of 1.8 kVA. Equipped with -T800 transputers, it costs around DM 500,000.

Parsytec GmbH, Jülicher Strasse 338, 5100 Aachen, West Germany. Phone (0241) 166000. FAX (0241) 1660050.

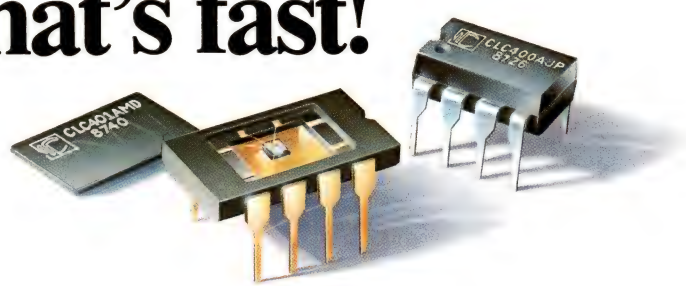
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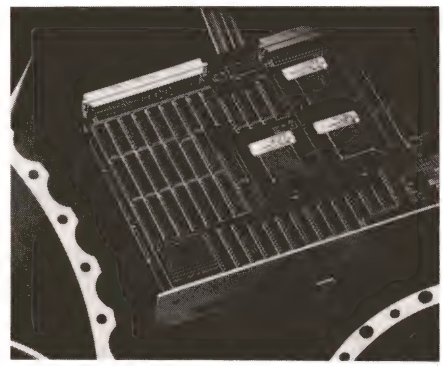
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CIRCLE NO 186

Adapter card lets you add RISC chip to existing development system

Using the JT-88000 adapter card, you can upgrade an existing 68020- or 68030-based development system so that it will run Motorola's 88000 RISC processor. The adapter card provides an 88000 CPU for stand-alone or VME Bus system use when coupled to one of the manufacturer's single-board computers.

The card houses an 88100 processor and two 88200 cache-memory-management units. One of these cache units provides a data-bus cache; the other provides an instruction-bus cache. You plug the double-Eurocard adapter board into the 68020 or 68030 PGA socket. Interface circuitry on the adapter board



converts 88000 32-bit memory accesses into 8-, 16-, or 32-bit 68020 or 68030 memory accesses.

The adapter board is also available coupled to the 88000-SBC single-board computer, which provides the RISC processor with 1M or 4M bytes of dual-ported, parity-protected, dynamic RAM; as much as 2M bytes of EPROM; two serial IO lines; and a VME Bus interface. The 2-board sandwich plugs directly into a VME-bus backplane. You can also add additional piggyback boards to increase functionality. The adapter card, including the RISC chip set, costs £4950; the 88000-SBC sells for £6950.

Integrated Micro Products Ltd, No 1 Industrial Estate, Medomsley Rd, Consett, Co Durham DH8 6TJ, UK. Phone (0207) 503481. TLX 537747.

Circle No 458

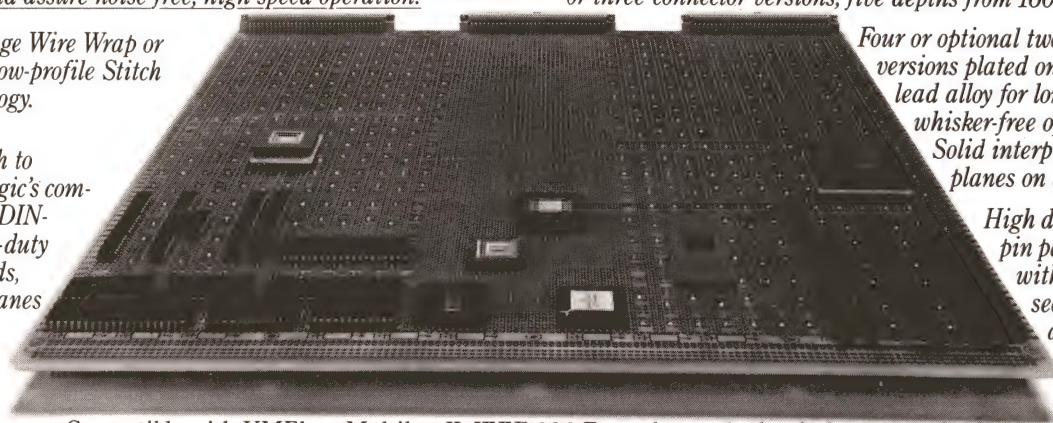
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OPTICAL-DISK DRIVE

The Model 810 optical-disk drive emulates magnetic-disk drives. The drive can run software and operating systems developed for Winchester devices without modification. It provides 810M bytes of storage capacity on a 5¼-in. removable cartridge. The double-sided cartridge conforms to ANSI standards. The drive's dual-μP architecture achieves 175-msec access times and data-transfer rates to 2.78M bps. The device has a SCSI host interface and is compatible with standard SCSI host adapters.

A multitiered error-correction scheme provides a 1×10^{-12} corrected bit-error rate after error checking and correction (ECC) and a 1×10^{-16} undetected bit-error rate after ECC and cyclic redundancy checking. If you use the drive with an IBM PC/AT, you can employ system software that removes the 32M-byte disk-size limitation of DOS; this software occupies less than 10k bytes of host memory. In addition to the Winchester emulation mode, the drive also supports the write-once, read-many mode. Single-drive system, $4995. Double-sided, 810M-byte cartridge, $189. Delivery, 60 days ARO.

LaserDrive Ltd, 1101 Space Park Dr, Santa Clara, CA 95054. Phone (408) 970-3600.

Circle No 650

3½-IN. DISK DRIVES

Swift Series 3½-in. disk drives come in eight models and have capacities of 55, 100, 150, and 200M bytes. The 200M-byte model offers an average seek time of 16.5 msec. Other models have either 16.5-msec or 25-msec average seek times. One of the 200M-byte models supports instructions for the SCSI interface. Other models have either ESDI or ST506 interfaces. All the drives use thin-film media and feature a dedicated servo surface. They employ low-mass, straight-arm actuators for positioning the read/write heads. The 200M-byte drives can achieve 10M-bps data-transfer rates, whereas the other models transfer data at either 5M or 7.5M bps. Their power dissipation ranges from 10 to 12W, and they have an MTBF of 30,000 hours. Their operating temperature range is 10 to 50°C. $5 to $8/megabyte.

Control Data Corp, Box 0, Minneapolis, MN 55440. Phone (612) 853-5795.

Circle No 651

BUS ADAPTER

The 404 IBM PC/AT Multibus I Adapter makes an PC/AT function as a processor on Multibus I. The adapter permits the PC/AT to serve as the bus master in Multibus applications and lets you use the wide variety of high-performance devices compatible with Multibus I. The product consists of two printed-circuit cards. One card fits inside the PC/AT, whereas the other fits inside a Multibus card cage. The two cards are connected by an EMI-shielded cable. As much as 15M bytes of Multibus memory can serve as PC/AT memory. The 16M bytes of Multibus address space are accessible in pages that range in size from 65k to 1M bytes. You can directly access Multibus I/O as PC/AT I/O. $1380.

Bit3, 8120 Penn Ave S, Minneapolis, MN 55431. Phone (612) 881-6955.

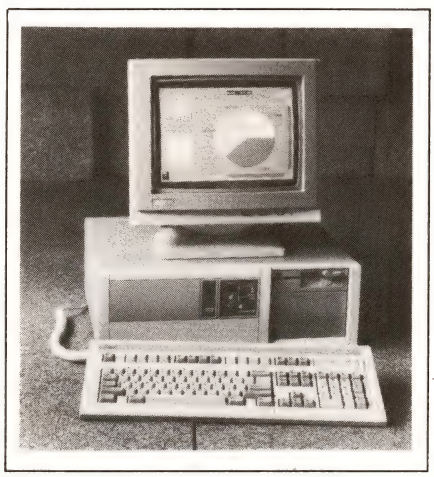
Circle No 652

SCANNER

The PCScan 2000 desktop scanner interfaces with the IBM PC, PC/AT, PC/XT, PS/2 and compatibles or with an Apple Macintosh Plus, SE, or Macintosh II computer. The device performs 8-bit gray-scale scanning and thus recognizes 256 shades of gray. You can set its resolution from 38 to 300 pixels/in. It typically takes 9.4 sec to scan a page. You can edge feed documents from 3.5×3.5 to 8½×14 in. into a front entry port; an optional automatic feeder with a 35-sheet capacity handles paper sizes from 6×6 to 8½×14 in. A SCSI interface connects the scanner to external devices. Two scanner models are available; one with and one without hardware that supports the vendor's optical recognition (OCR) software. Model with OCR hardware, $2195.

DEST Corp, 1201 Cadillac Ct, Milpitas, CA 95035. Phone (408) 946-7100. TLX 299823.

Circle No 653



80386 COMPUTER

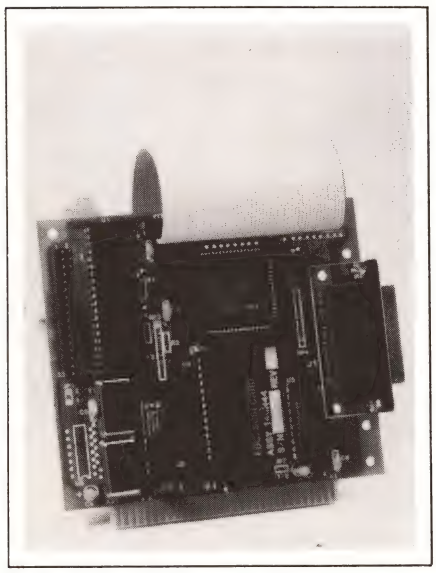
The Premium/386 20-MHz 80386-based personal computer provides the multitasking benefits of IBM's Micro Channel architecture and yet also features IBM PC/AT hardware and software compatibility. It is a single-user, multitasking machine suitable for CPU- and memory-intensive applications. You can obtain four models, all of which have seven expansion slots, one 32-bit dedicated memory slot, three 16-bit PC/AT-compatible SmartSlots, one 8/16-bit standard PC/AT slot, and two 8-bit standard PC/XT slots.

The SmartSlot architecture has three components: a dedicated 32-bit pathway from the processor to memory, a feature bus, and an arbitration bus. You can load coprocessors for graphics, communications, and disk control into the three SmartSlots. Other features of the

various models are memory capacity to 13M bytes, three user-selectable speeds, a disk controller, and hard disks, having a 40M- to a 150M-byte capacity. A 1.2M-byte drive, a keyboard of 101 keys, two RS-232C ports, and one parallel port are standard on all the machines. The systems can each support as many as four drives. $4695 to $8995.

AST Research Inc, 2121 Alton Ave, Irvine, CA 92714. Phone (714) 863-1333.

Circle No 654



SCSI CONTROLLER

The SM911 SCSI controller card for IBM PC and PC/AT buses can control as many as seven serially chained floppy-disk drives or hard disks providing as much as 2.8G bytes of storage. The 4×4½-in. card consumes <10W and transfers data at a 10M-bps rate. It comes with 50- and 34-pin connectors for the control of internal floppy-disk drives, and with a 25-pin connector for the control of an external SCSI drive. The card's internal ROMBIOS contains software drivers for two 33M-byte drives. Software drivers provided on floppy disks support large SCSI disks, optical drives, tape drives, Xenix operating systems, and the Novell operating environment. The board contains diagnostic routines that test the SCSI bus for connected drives, prepare the drives for use or formatting, and ascertain the type and size of the SCSI device. $159.

Tega Technologies Inc, 1040 E Chapman Ave, Orange, CA 92666. Phone (714) 771-5128.

Circle No 655



12-LB LAPTOP

The 1520 battery-powered laptop computer is based on a 10-MHz 80C286 μP and runs on MS-DOS version 3.2 Extended. It will run OS/2 when that software becomes available. Its standard features include a 10-in. LCD; 1M byte of RAM; two 1.4M-byte, 3½-in. internal floppy-disk drives; and as much as 512k bytes of user-installable ROM. The computer comes with a 72-key keyboard, weighs 12 lbs, and is enclosed in a 2.3×11.5×15.0-in. magnesium case. It has an RGB video port, a 25-pin external floppy-disk-drive port, an RS-232C port, a parallel port, a port for an external keyboard, and a port for an expansion bus.

Options include 640×200- and 640×400-pixel gas-plasma displays, a 40M-byte hard disk, an 80287 coprocessor, a 2400/1200/300-baud internal modem, internal and external nickel cadmium rechargeable-battery packs, and expansion cartridges that offer 3270, video-graphics-adapter (VGA), and GridLink LAN support. $3495.

Grid Systems Corp, Box 5003, Fremont, CA 94538. Phone (415) 656-4700.

Circle No 656

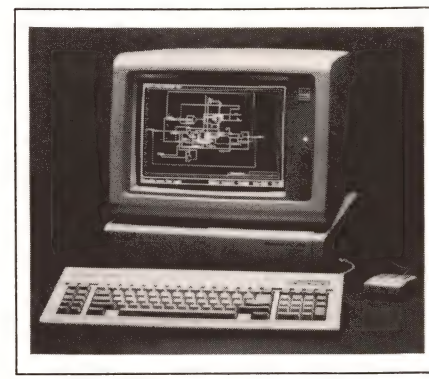
I/O CONTROLLER

The AutoScan board for the VME Bus or the Multibus I controls as many as 32 I/O devices. The board uses a 24-MHz TI TMS99105A μP and 64k bytes of dual-port static RAM; it has a data-transfer rate of 9600 baud with 32 users. With 16 users, it achieves a 19.2k-baud transfer rate. The single-expansion-slot board provides 32 full-duplex asynchronous or 16 synchronous serial I/O ports. It has four RS-232C outputs that drive 8-port distribution pods as far as 50 ft. The pods can be configured with DB25, DB9, or RJ connectors. When connected to four pods, the board can service 32 devices through four separate cables without daisy chaining.

The board acts as a slave device capable of both 8- and 16-bit transfers. Its 64k bytes of RAM can be placed on any 64k-byte boundary within a standard 16M-byte bus address space. The board's control registers, located within an 8-byte block of I/O address space, allow a bus master to start or stop the execution of firmware at any time. Multibus I version, $3595; VME Bus version, $3995.

Ariel Systems Inc, 8545 Arjons Dr, Suite I, San Diego, CA 92126. Phone (619) 549-0134.

Circle No 657



COMPUTER

The Network PC 386 is a PC/AT compatible computer that uses a 16-MHz 80386 μP. Running MS-DOS, the machine can serve as a desktop workstation in a LAN. It

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8086	8035		68HC11A2		6301X		6504		1806		Z80H
8088	8039		68HC11A8		6301Y		6505		CDP6805C4		Z180
80186	8344		6802		6303R		6506		CDP6805C8		Z8001
80188	8048		68B02		6305V		6507		CDP6805D2		Z8002
80286	8049	68000	146805E2		63705		6512		CDP6805E3		
	8050	68008	6803		6309		6513	**Harris:**	80C86	**NEC:**	V20 V40
	8051	68010	6808		6309E		6514		80C88		V30 V50
	8085A		68B08		64180R0		6515	**National:**		**Signetics:**	8X300
	8085A2		6809		64180R1				NSC800		8X305
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*Assumes EZ-PRO Development Station connected to MSDOS host.

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CIRCLE NO 165

features EGA (enhanced graphics adapter) capability, 1M byte of RAM, one serial and one parallel port, and a floppy-disk-drive controller. It has four minislots that accept 256k-byte dynamic RAM modules in single in-line-memory-module packages. Its 16k-byte cache memory automatically switches word width to handle 8-, 16-, and 32-bit instructions and data transfers. The unit features a real-time clock/calendar with battery backup and can accommodate a half-height 5¼-in. floppy-disk drive. You can obtain a 1.2M-byte floppy-disk drive and a 40M-byte hard disk as options. Three AT-compatible expansion slots are standard. An AT-compatible ROM BIOS lets the computer run AT application programs. Diskless version, $3299 to $3499.

Convergent Technologies, 2700 N First St, San Jose CA 95134. Phone (408) 434-2848.

Circle No 658



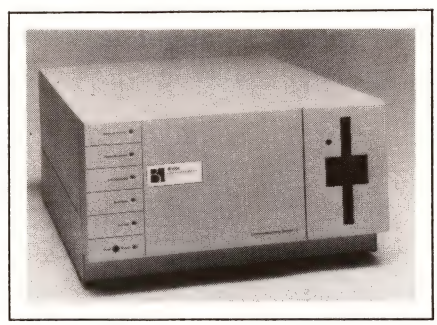
MULTIMETER

The Multimeter Based Data Acquisition System has a built-in data bus that lets you display measured data on a computer monitor. It connects to an RS-232C interface box that connects to your computer and functions as a data recorder/analyzer or as automatic test equipment. Besides measuring dc and ac voltage, dc and ac amperage, and resistance, it checks diodes and transistors. Its dc-voltage measurement is accurate to within 0.5%.

The multimeter operates from a 9V battery and has a built-in stand. The system's data-acquistion and communication software runs on an IBM PC/XT, PC/AT, or a compatible computer. You can enter the data manually or have it automatically entered. You can obtain optional adapters to measure humidity, temperature, dc or ac current, rpm, light level, and air velocity. Data-transmission rates range from 9600 to 1200 baud. An optional data transmitter and data receiver enable you to send data at 1200 baud over ordinary telephone lines without the need for a computer. Multimeter, $89; RS-232C interface, $149; DB-25 cable, $29; software, $29; transmitter, $269; and receiver, $269.

Extech Instruments Corp, 150 Bear Hill Rd, Waltham, MA 02154. Phone (617) 890-7440.

Circle No 659



LAN SERVER

The CS/1-OSI LAN communications server implements the full 7-layer Open System Interconnection (OSI) protocol as defined by the International Organization for Standardization (ISO). It can connect as many as 64 computing and peripheral devices to a LAN. These devices can include asynchronous, bit- and character-synchronous, and IBM-3270 Category-A devices. The server is also compatible with the Technical and Office Protocols (TOP) version 3.0, a specification of the OSI protocols layered over Ethernet (IEEE 802.3). In addition to Ethernet, the server is available in versions for token-ring LANs (IEEE 802.5) and for the vendor's 5M-bps CSMA/CD broadband LANs.

The server's architecture uses a 16-MHz 68020 main μP and several 68000 μPs to offload communication-processing tasks from the host. A network-user log-in feature permits the independent configuration of each port in order to restrict access. The server also has a built-in packet generator, which lets you perform network diagnostics while the network is operational. Eight-port version, $9900; 64-port version, $16,000. OSI software, $250. Delivery, 90 days ARO.

Bridge Communications Inc, 2081 Stierlin Rd, Mountain View, CA 94043. Phone (415) 969-4400. TLX 176544.

Circle No 660

FRAMESTORES

The Synergy framestore for the IBM PC/XT, PC/AT, and compatibles contains a real-time TV-signal image processor. The framestore can digitize the luminance information contained in an RS-170, NTSC, or PAL TV signal, or in a slow-scan video signal, and will store it with 16-bit resolution in its 768×512-pixel video memory. After processing, you can display the image in monochrome or pseudocolor on a standard TV monitor. To ensure a flicker-free display, the framestore preprocesses slow-scan video signals before storing them in the video memory. Onboard image-processing capabilities include convolution, interpolative zooming, signal averaging, or weighting to eliminate picture noise, and zonal or feature coloring that uses 256 of a possible 16M colors. You can also compile subframes into a movie sequence of images and return processed images to the framestore or transfer them to the PC's disks.

A lower-cost version—designated Synapse—has a 512×512-pixel, 8-bit/pixel framestore. Its display format and 15-MHz sampling rate produce square pixels when you use it with 625-line, 50-Hz, interlaced composite video monitors. Both

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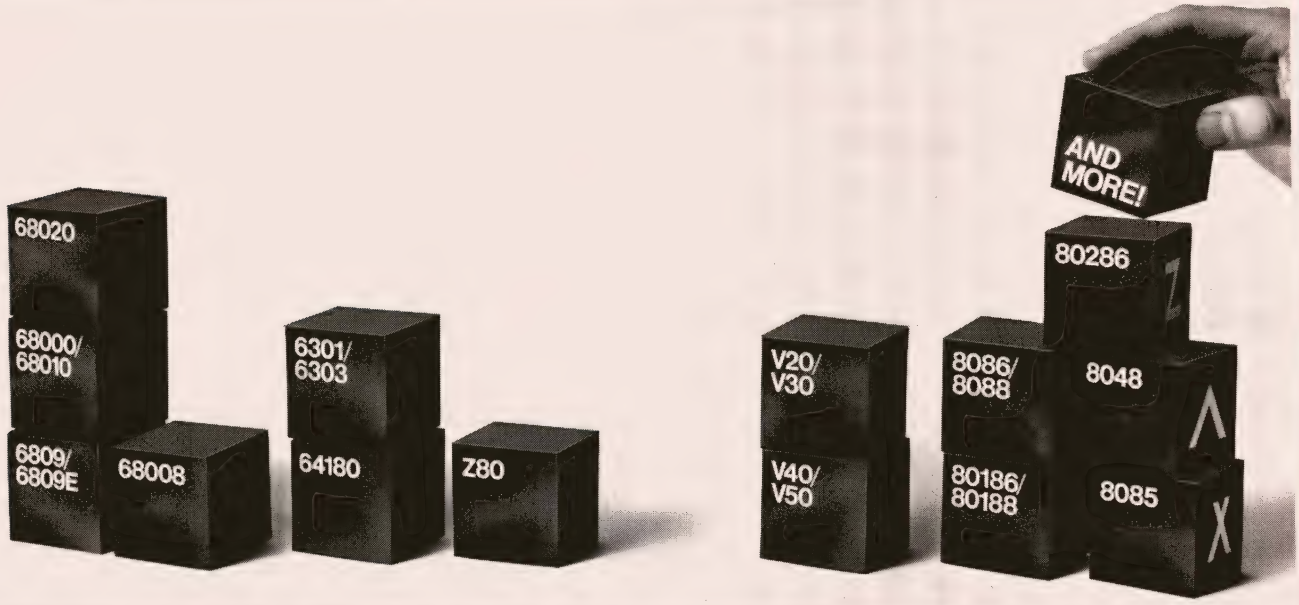
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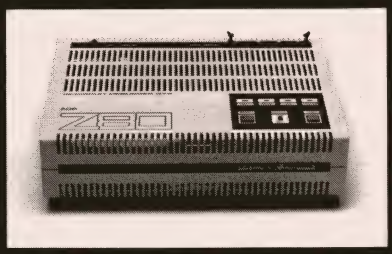
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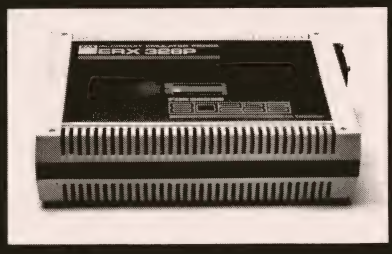
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ZAX

Zax Corporation

CIRCLE NO 189

framestores come complete with the vendor's MicroSemper image-processing software. Synergy, £7500; Synapse, £5500.

Synoptics Ltd, 15 The Innovation Centre, Cambridge Science Park, Milton Rd, Cambridge CB4 4BH, UK. Phone (0223) 863223. TLX 81417.

Circle No 662

GRAPHICS CARD

The VIP video graphics adapter (VGA) card works with the IBM PC, PC/XT, PC/AT, PS/2 Model 30, the Compaq Portable PC, and compatibles. The card can display all 17 VGA modes on analog monitors. It can also display enhanced-graphics-adapter (EGA) text and grahics on all IBM-compatible digital monitors. The card automatically switches to analog mode if you connect an analog monitor. Its SoftSense mode-switching feature switches your software to the correct mode. The card provides 800×560-pixel resolution max on multisync monitors and, in analog mode, can display as many as 256 of a possible 256,000 colors. The board also works with the color graphics adapter (CGA) and the Hercules monochrome graphics standard. It comes with both 9- and 15-pin connectors for use with either digital or analog monitors. $449.

ATI Technologies Inc, 3761 Victoria Park Ave, Scarborough, Ontario, Canada M1W 3S2. Phone (416) 756-0711.

Circle No 661

VME BUS CONTROLLER

The CC-101 system-controller module, which you plug onto the back of a VME Bus backplane's J1 connector, frees a board slot for a VME Bus card. The controller module measures 100×60 mm and includes both system-controller functions and active or passive termination networks. The system-controller functions include generation of the 16-MHz VME Bus system clock and 2.9-MHz serial clock; a 4-level priority or round-robin bus arbiter; bus time-out generator; and power-on or switch-activated reset operations. The board consumes 800 mA with active bus-termination networks and 1.7A with passive termination networks. It has an operating range of 0 to 70°C. $280.

CompControl bv, Stratumsedijk 31, 5600 AD Eindhoven, The Netherlands. Phone (040) 124955. TLX 51603.

Circle No 663

CompControl Inc, 15466 Los Gatos Blvd, Suite 109-365, Los Gatos, CA 95032. Phone (408) 356-3817. TWX 510-601-2895.

Circle No 664

DISK CONTROLLER

To achieve disk access at data rates as high as 500k bytes/sec, the FCM1 floppy-disk-drive controller card for G64 Bus systems incorporates 8k bytes of onboard disk-caching memory and a DMA controller that regulates data-transfer between the cache memory and floppy-disk-drive controller. The Eurocard board interfaces with as many as four 3½-, 5¼-, or 8-in. floppy-disk drives and handles any combination of single- or double-sided, single- or double-density drives. The device operates from a 5V supply and consumes 600 mA. You can obtain a driver for the OS9 operating system. £318.

Syntel MicroSystems, Queens Mill Rd, Huddersfield, Yorkshire HD1 3PG, UK. Phone (0484) 535101. TLX 51194.

Circle No 665

STD BUS BOARD

The Model 8020 all-CMOS CPU board for the STD Bus uses a 64180 4.6-MHz microcontroller chip. The board features three memory sockets, two of which have 32k bytes of battery-backed RAM. The remaining socket contains Debug software. You can also use this socket to hold a

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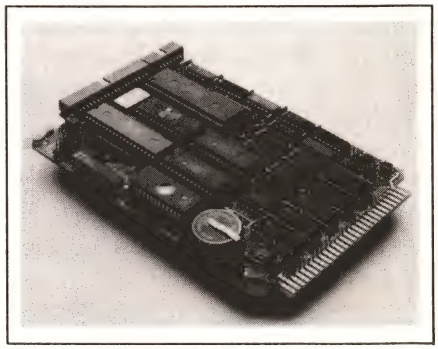
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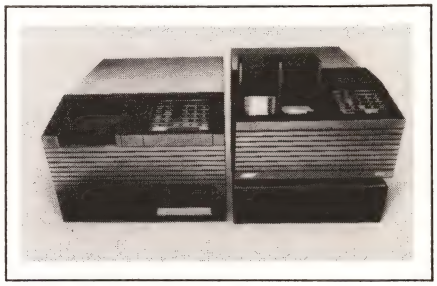
27C256 EPROM (CMOS) or, if all-CMOS operation isn't required, a 27512 EPROM. The board's 64180 μC has two RS-232C ports with programmable baud rates. The board also has a synchronous, half-duplex serial I/O channel and a Z80 PIO IC that provides two 8-bit channels. An 8-channel, 8-bit A/D converter furnishes data acquisition through 0 to 5V inputs.

Other features of the board include two 16-bit and four 8-bit cascadable counter timers, one watchdog timer, two DMA channels, and a battery-backed clock calendar. You can use the board's Debug firmware to link it to an RS-232C device or to an IBM PC or compatible computer. You can download Intel Hex-formatted code from your IBM PC or compatible and execute it in RAM with a breakpoint. The board's power requirements are +5V at 90 mA, +12V at 1 mA, and −12V at 4 mA. $395; with A/D converter, $445.

CμBit, 190 S Whisman Rd, Mountain View, CA 94041. Phone (415) 962-8237. TLX 797377.

Circle No 666





DISK COPIERS

MST Replica! Series diskette duplicators let high-volume software publishers make as many as 300 copies/hour of 3½-, 5¼-, and 8-in. double-sided media at each of their copy stations. The copiers can handle disks compatible with MS-DOS-based computers and with the Commmodore Amiga, the Apple, Macintosh, Atari, DEC, and Wang computers. A user-programmable batch mode permits the automatic duplication of several masters from either a hard- or floppy-disk original. The units can operate unattended after their initial set up. They can record serial numbers. You can order copiers whose options let you copy between various 5¼- and 3½-in. floppy disks or allow you to use an IBM PC, PC/XT, or compatible to copy disks intended for



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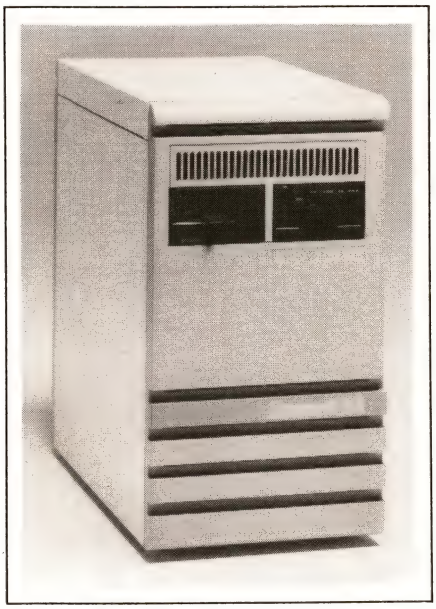
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Computers and Peripherals

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Media System Technology Inc, 16812 Hale Ave, Irvine, CA 92714. Phone (800) 443-8515; in CA, (714) 863-1201. TLX 4992344.

Circle No 667



COMPUTERS

Suitable for small offices, the 210 Series 32-bit computers run the vendor's Office Network Exchange Plus, a departmental software system. Each of the computers comprises three custom VLSI chips: a 32-bit CPU, an integrated memory controller (CIM), and a virtual memory management unit (VMMU). The CIM provides data and address management for the CPU, whereas the VMMU organizes the data space into segments, which facilitates shared access of data. Each program can use as much as 2G bytes of virtual memory space.

The Model 211 executes approximately 0.7 MIPS; you can configure it with an optional 8k bytes of cache memory to achieve execution of 1 MIPS. You can select a 37M-, 68M-, or 142M-byte fixed-disk storage unit for integration into the system. Model 211 with 32-bit CPU, 2M bytes of memory, six asynchronous communications ports, a peripheral controller, a 37M-byte hard disk, an integrated streamer-tape drive, and an HVS 6 Plus operating system, $17,130.

Honeywell Bull Inc, 300 Concord Rd, Billerica, MA 01821. Phone (617) 671-2517.

Circle No 669



PRINTER ADAPTER

The USA/PC enables IBM PCs or compatibles and IBM PS/2 computers to drive high-speed laser printers and Xerox ion-deposition printers. It drives high-speed laser printers by Datagraphics, Hewlett-Packard, IBM, Kodak, NCR, Siemens, and Storage Technology. Computers such as the PS/2 Model 80 and the Compaq 386, which employ 80386 μPs, or machines such as the PS/2 models 30 and 60, which employ 80286 μPs, can drive the Xerox 8700 and 9700 and the IBM 3800 at full speed. IBM PCs or compatibles and the PS/2 models 25 and 30 can drive the Xerox 4050 and 4060 ion-deposition printers, which feature maximum operating speeds of 50 and 60 pages/min, respectively. You can also access printer features such as an unlimited selection of type fonts, type sizes ranging from four to 24 points, variable-line and -character spacing, variable-page width, and the capacity to print on both sides of a sheet of paper. $9000.

Spur Products Corp, 13469 Beach Ave, Marina Del Rey, CA 90292. Phone (213) 822-7100.

Circle No 668

Continued on pg 280

Because you're thinking fast... count on us for the speed you need.

Now, 19ns settling op amps that survive saturations and shorts...

Comlinear's two new high-speed op amps bring you built-in protection against saturation. Plus simple short-circuit protection. That means easy solutions for fast input and output amplifiers in systems where signal level or load can't be controlled.

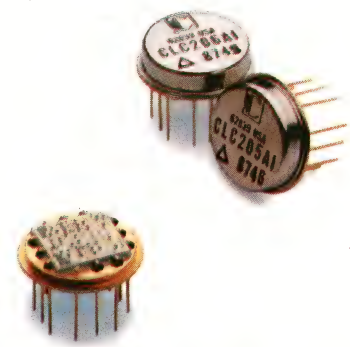
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RISC processor, 170 or 100 nanoseconds. 20MHz Motorola 68881 Floating Point unit

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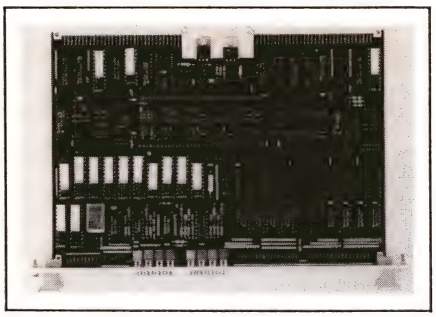
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To arrange for a call from an IBM marketing representative or an IBM industry remarketer, or for literature, call 1-800-IBM-2468, Ext. 41.

IBM The Bigger Picture



DATA-CAPTURE BOARD

The HSM8170 data-acquisition board for VME Bus systems can capture 1M bytes of data arriving at 40M bytes/sec. For longer data bursts, you can chain as many as eight of the boards together to capture 8M bytes of data without any data loss. You can operate a pair of boards as swinging buffers, with one board accepting new data while the other board outputs the data via the VME or VSB Bus.

Data transfers to the VME or VSB Bus can take place at speeds of 6.5M bytes/sec max. By using the company's FIC8230 high-speed processor board, you can establish a 40M-byte/sec, 32-bit-wide DMA channel to the HSM8170 on the VSB Bus. The standard board's data input port interfaces to a LeCroy FERA read-out bus, allowing you to connect it to FERA bus, Fastbus, or Camac systems. Other input configurations allow the board to accept ECL-, single-ended TTL-, or differential TTL-level data. You can transfer data to the data input port synchronously or asynchronously using various handshaking protocols. $4500 (50).

Creative Electronic Systems SA, 70 route du Pont-Butin, 1213 Petit-Lancy 1, Switzerland. Phone (022) 925745. TLX: 421320.

Circle No 691

C E Systems (US) Inc, 4655 Old Ironsides Drive, Suite 370, Santa Clara, CA 95054. Phone (408) 727-3360. FAX (408) 727-7721.

Circle No 692

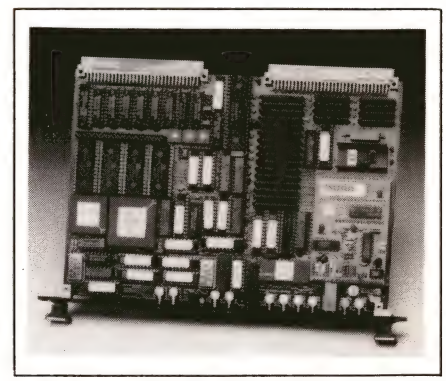


IMAGE PROCESSOR

The IPC image-processing board provides either a stand-alone image processor or an image-processing subsystem for VME Bus systems. It includes a frame grabber, a frame store, a color look-up table, an analog video output, a 68020 μP, and 1M bytes of dynamic RAM. You can add a 68881 math coprocessor. The board features four video inputs that are digitized to 6- or 8-bit resolution 15M samples/sec max. You can program the board to accept



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either CCIR- or EIA-compatible video signals or other video signals.

A 512k-byte, dual-ported video RAM stores pixel information. The RAM can store a single frame with a resolution as high as 1024×512 pixels, or two 512×512-pixel frames. The video RAM is separate from the processor's 1M-byte local memory. A video ADC and a color look-up table let you display gray-scale or pseudocolor images. The board provides two serial I/O lines and space for 512k bytes of EPROM. Software support includes the OS/9 operating system with drivers for communication to a VME Bus host processor and the company's TopPic image-processing software-development tools. DM 6800.

Eltec Elektronik GmbH, Galileo-Galilei-Strabe 11, D-6500 Mainz 42, West Germany. Phone (06131) 50630. TLX: 4187273.

Circle No 693

American Eltec Inc, 569 S Marengo Ave, Passadena, CA 91101. Phone (818) 449-1558.

Circle No 694

GRAPHICS PROCESSOR

The FAB210 is a color-display coprocessor card for Multibus II systems. It includes an 80286 CPU with a 32k-byte local RAM, a 256k-byte EPROM, and two 82786 graphics processors that can access as much as 4M bytes of onboard video RAM. When the card is in the noninterlaced mode, you can display images at a maximum resolution of 1024×768 pixels.

The video RAM can store as many as four, separate full-resolution images. You can transfer video information to the video RAM either via the Multibus II iPSB Bus or the board's iLBX-II Bus interface. The board can display video camera images and overlay the images with graphics information. The video output is via a 75Ω, RGB analog output and two TTL video outputs. Additional onboard facilities include two RS-232C interfaces. Fr 48,000.

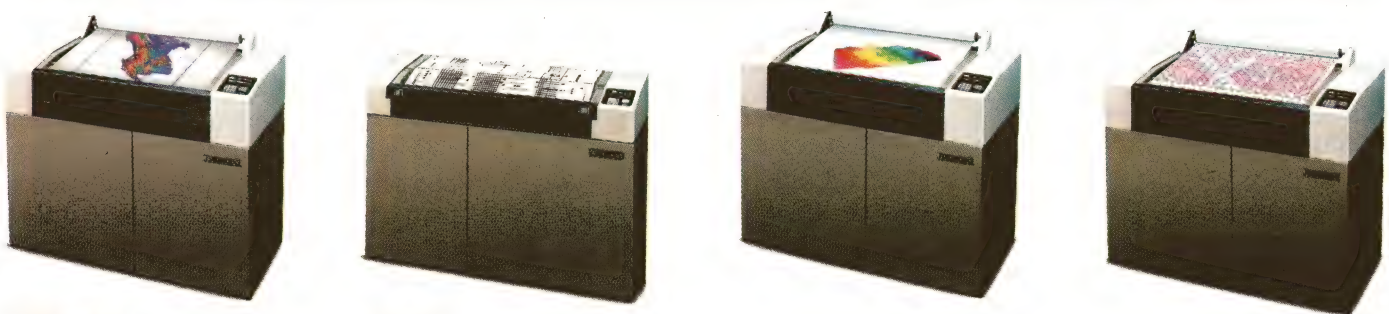
Centralp Automatismes, 16 rue Gabriel Pèri, 92120 Montrouge, France. Phone (1) 42533617. TLX: 632380.

Circle No 695

GRAPHICS DISPLAY

The Xcellerator 1600 color-graphics display systems provide display resolutions of 1600×1200 pixels, and are compatible with both IBM PC/AT and PS/2 computer architectures. They have 20-in. diagonal displays. They also incorporate Texas Instruments' 34010 32-bit graphics system processor to achieve continuous vector drawing speeds in excess of 80,000 vectors/sec and 8×16-pixel character generation at 25,000 characters/sec.

One operating mode displays 16



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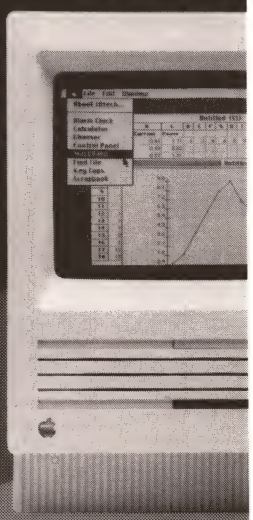
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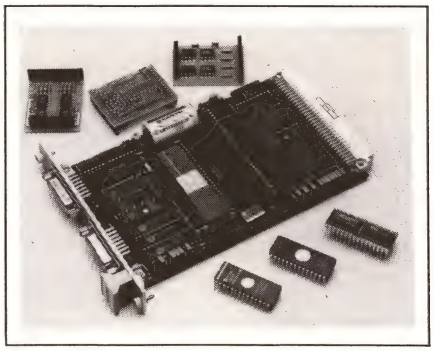
colors from a palette of 4096 colors at a resolution of 1600×1200 pixels. The second mode emulates the company's original display system, displaying 256 colors from a palette of 16.7M colors at a resolution of 1024×768 pixels. The systems include 1M bytes of display-list RAM, but you can upgrade them to 8M bytes. The systems also include software drivers that allow you to use them with Microsoft Windows and and DGIS. Around £5500.

Cambridge Computer Graphics Ltd, Graphics House, Convent Dr, Waterbeach, Cambridge CB5 9QT, UK. Phone (0223) 863311. TLX: 817274.

Circle No 696

Cambridge Computer Graphics Ltd (USA), 6114 Lasalle, Suite 435, Oakland, CA 94611. Phone (415) 530-4148.

Circle No 697



MULTIFUNCTION CARD

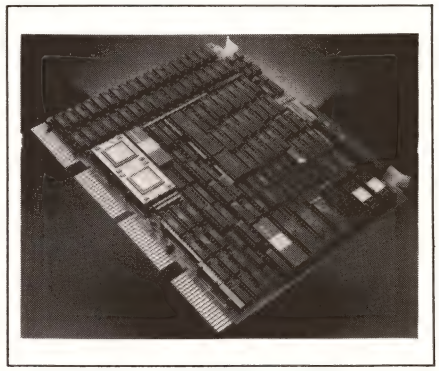
The VMFB single-Eurocard board for the VME Bus provides a variety of system and I/O functions. The board includes a 68562 IC to provide two serial I/O ports and a 16-bit timer counter, a 68230 IC with 16 parallel I/O lines, a 24-bit timer, and an ICM7170 battery-backed, real-time clock/calendar. The board also provides space for a 64k- or 256k-byte ROM or a battery-backed static RAM. It includes system wake-up and sleep functions and a hardware watchdog timer. The board's VME Bus slave interface features five programmable VME Bus interrupt levels, short and standard address-mode access to the board's I/O facilities, and standard address-mode access to its memory. DM 870 (100).

Pep Modular Computers GmbH, Am Klosterwald 4, 8950 Kaufbeuren, West Germany. Phone (08341) 81001. TLX: 541233.

Circle No 698

Pep Modular Computers Inc, Carnegie Office Park, 600 N Bell Ave, Pittsburgh, PA 15106. Phone (412) 279-6661. TLX: 6711521.

Circle No 699



Q BUS COMPUTERS

Based around DEC's J11 μP and an optional FPJ11 floating-point accelerator, the M80 and the M90 Q Bus single-board computers are compatible with PDP operating systems and software. Housed on quad-sized cards, the boards plug directly into standard 22-bit Q Bus backplanes and are downward compatible with the 16-/18-bit LSI-11 bus.

The M80 runs at 15 MHz; the M90 runs at 18.5 MHz. Both boards are available with 1M to 4M bytes of zero-wait-state, parity-checked dynamic RAM. You can expand the memory of the 1M-byte versions to 4M bytes with off-board memory. The boards support normal- and block-mode DMA transfers between the onboard dynamic RAM and other Q Bus modules. Additional onboard facilities include four DLV11-J-compatible serial I/O lines, space for 32k bytes of bootstrap EPROM, and a real-time clock. Most board functions are software configurable via a configuration EEPROM. An M80 with 1M-byte dynamic RAM, £2500; an M90

with 4M-byte dynamic RAM, £5150 (50).

Mentec Computer Systems Ltd, Mentec House, Dun Laoghaire Industrial Estate, Pottery Rd, Dun Laoghaire, County Dublin, Ireland. Phone 858444. TLX: 30447.

Circle No 700

SCSI BOARD

The TP600, a SCSI bus controller board for Multibus II systems, features two independent synchronous and asynchronous SCSI bus interfaces, an onboard 68020 μP, and 1M to 4M bytes of parity-checked dynamic RAM. Separate DMA controllers handle data transfers between the iPSB message-passing coprocessor (MPC) and onboard memory, and transfers to and from the SCSI buses. The DMA controller that transfers data between the MPC and onboard memory is configured as a 32-bit controller to maximize iPSB bus throughput. The DMA controller that transfers data to and from the SCSI bus interfaces has a 32-byte buffer that allows it to convert 8-bit SCSI bus data transfers into 32-bit memory transfers. The memory-protection scheme allows you to partition the onboard memory so that you can implement onboard executive programs or a multitasking operating system. £3423.

Tadpole Technology plc, Titan House, Castle Park, Cambridge CB3 0AY, UK. Phone (0223) 461000. TLX 818152.

Circle No 706

Tadpole Technology Inc, Suite K, 6747 Sierra Ct, Dublin, CA 94568. Phone (415) 828-7676.

Circle No 707

INDUSTRIAL PC

The STE-PC consists of four single-Eurocard computer boards and enables you to install an IBM PC compatible computer in an STE Bus system. This configuration allows you to take advantage of the software-development tools available for the IBM PC, and also provides ruggedized hardware and an extensive range of I/O cards for industrial-control applications. The SCPC88 CPU card runs an 8088 μP at 4.77 MHz, and it includes 256k bytes of RAM, a socket for an 8087 math coprocessor, and a BIOS that ensures 100% IBM PC compatibility. You can add a RAM card to increase memory to 640k bytes. The SPEGA graphics card provides EGA and CGA compatibility. The SPDC card controls as many as four standard 5¼- or 3½-in. floppy disk drives. The SPCOM card provides two serial I/O ports and one parallel port for data communications and the connection of printers.

For target systems that don't re-



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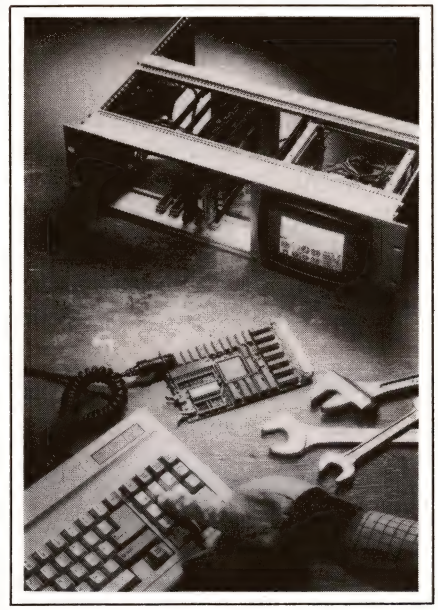


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quire disk or communications capabilities, you can replace the SPEGA, SPDC, and SPCOM cards with an SPCGA graphics card. This card provides CGA-, MDA-, and Hercules-compatible graphics and includes four byte-wide memory sockets for as much as 128k bytes of RAM or 256k bytes of EPROM. SCPC88, £345; SPEGA, £385; SPDC, £185; SPCOM, £159; SPCGA, £195.

Arcom Control Systems Ltd, Unit 8, Clifton Rd, Cambridge CB1 4WH, UK. Phone (0223) 411200. TLX 94016424.

Circle No 705

BUS STIMULATOR

The CVMEBS1 bus-stimulus module generates VME bus-interrupt and -arbitration functions. Pushbuttons allow you to generate a VME bus interrupt on any one of the bus's seven interrupt levels, or you can generate a bus request on any one of the four bus-request lines. For interrupts, you can also set the eight least significant bits of the Status/ID word. In addition to stimulating legal interrupt and bus-request cycles, you can also generate spurious interrupts or bus requests to test the system's response to ghost conditions. $1995.

Concise Technology, Alpha House, Treforest Industrial Estate, Treforest, Mid Glamorgan CF37 5YG, UK. Phone (0222) 620208. TLX 975646.

Circle No 708

IMAGE SCANNER

The desktop IX-12F image scanner can scan documents for text, graphs, drawings, maps, and pictures, and can enter them into a computer. It can scan images at a speed of 16 sec/page and can provide a resolution of 300 dots/in. It offers 32 levels of halftones, a useful feature for photo reproduction. The scanner has a CCD sensor and a halogen light source. An optional automatic document feeder can handle as many as 20 letter- or legal-size sheets of paper. The unit measures 14.5×21.5×3.5-in. You can use an interface board to connect it to one of the vendor's personal computers or to an IBM PC, PC/AT, or a compatible computer. Scanner, $1495; document feeder, $595.

Canon USA Inc, System Div, 1 Canon Plaza, Lake Success, NY 11042. Phone (516) 488-6700.

Circle No 670

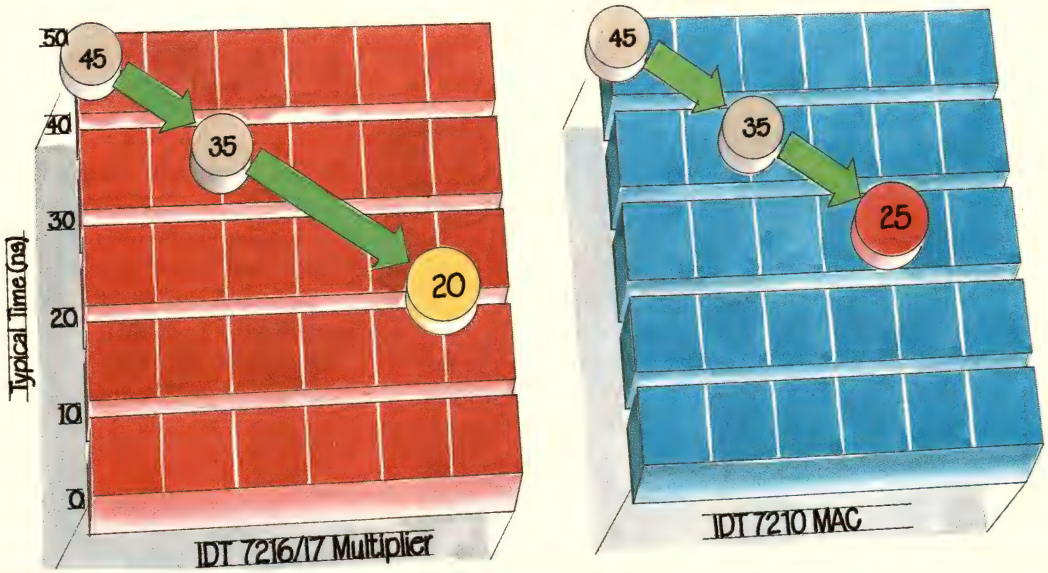


PERIPHERAL DEVICE

The R414 peripheral device for the IBM PC provides four data-acquisition channels. Its sampling rates range from 1 to 500 kHz, and its 8-bit A/D converter triggers an internal or external analog signal. You can adjust the unit's gain so that the analog-input voltage ranges from 10 mV to 320V p-p. All of the unit's inputs have diode protection. The unit comes with user programs and subroutines written in C, Turbo

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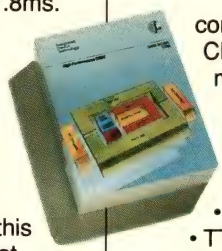
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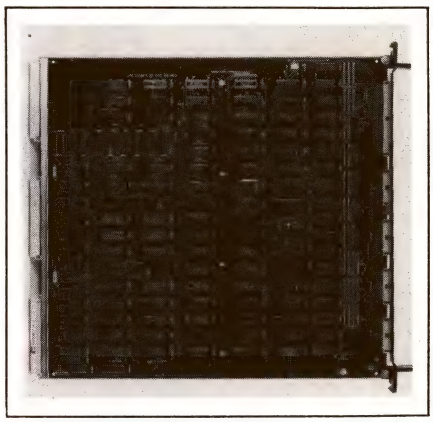
Pascal, or Basic. You can obtain software that lets you operate the unit as a digital oscilloscope or spectrum analyzer; digital signal-processing hardware is also available. $295.

Rapid Systems, 433 N 34th St, Seattle, WA 98103. Phone (206) 547-8311. TLX 265017.

Circle No 671

DISK CONTROLLER

The Rimfire 3220, an enhancement of the Rimfire 3200, is a VME Bus disk-controller board for Sun 3 workstations. The board has the same dimensions as do Sun's triple-high and -wide cards, and it can support four SMD/SME drives via faceplate connections. It uses an 80186 μP to manage a 512k-byte



segmented cache memory; the cache eliminates unnecessary seek and rotational delays by prereading disk files that span track boundaries. The board can handle SMD E-drive data rates to 24 MHz and can burst data across the VME Bus at rates in excess of 30M bytes/sec. Software support includes device drivers for Unix BSD 4.2 and SunOS. You can also obtain software that boots a Sun 3 workstation directly from the controller. $3495.

Ciprico Inc, 2955 Xenium Lane, Plymouth, MN 55441. Phone (612) 559-2034.

Circle No 672

HANDHELD TERMINAL

The MultiPortable pocket-size data terminal uses an 8-bit μP that features communications circuits for DTMF (dual tone multiple frequency) and tone transmission. The μP also provides audio-tone monitoring and pulse-width timing for tone detection. The terminal has 64k bytes of internal memory, an 8-bit parallel port, an RS-232C port, and three I/O and control ports. The package includes a 66-character qwerty keyboard and a 2-line, 32-character LCD. An optional 1200-bps modem transfers data via two RJ-11 telephone-jack interfaces.

When functioning as a voice terminal and "smart" telephone, the unit stores names, addresses, and numbers in a directory that enables it to perform automatic dialing. One edge of the terminal contains a Memocard access port. This port



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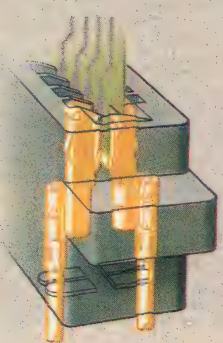
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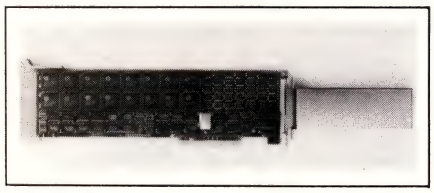
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Multimil Inc, 670 International Parkway, Suite 190, Richardson, TX 75081. Phone (214) 644-7724. TLX 286258.

Circle No 673



COMM BOARDS

PS-COM/X Series boards for the IBM PS/2 models 50, 60, and 80 feature either 8 or 16 asynchronous serial communications ports per board. You can mount as many as four of these 16-channel boards on the PS/2 Bus to provide 64 serial ports. You can select data-transfer rates from 50 to 56k baud for each port. The boards use high-speed 16450 UARTs and are compatible with the DOS, OS/2, Xenix, Unix, Theos, Pick, QNX, and PC-MOS operating systems.

Each port provides full modem control. You can mount as many as 16 RJ-45 connectors in a compact, shielded extension that mounts on the faceplate connector extending from the board. The connector allows you to use multiple boards in a system that has either RJ-45 or RJ-11 cabling. COMware software allows DOS to access as many as 64 COM ports. Eight-port version, $895; 16-port version, $1295.

DigiBoard Inc, 6751 Oxford St, Saint Louis Park, MN 55426. Phone (800) 344-4273; in MN, (612) 922-8055.

Circle No 674

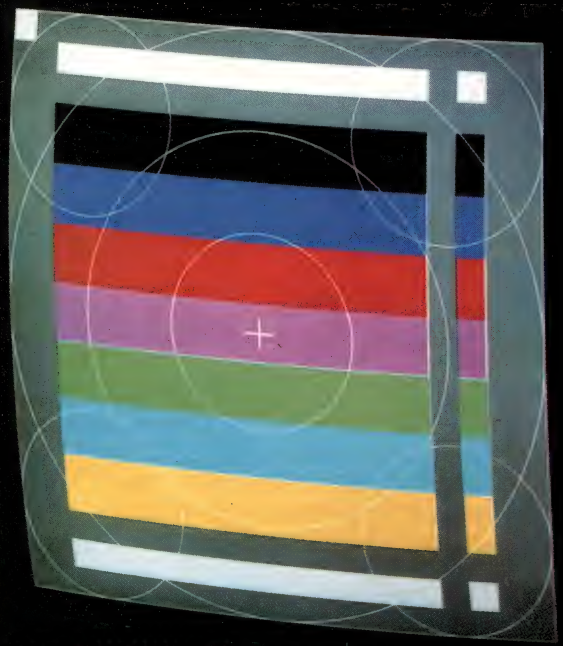


ACS 8250 an X.25 Switch and Concentrator.

SWITCH/CONCENTRATOR

When used as a switch, the ACS 8250 packet switch and line concentrator for X.25 network communications interconnects as many as eight X.25 lines. When used as a concentrator, it permits six interconnected X.25 lines to access a high-speed X.25 trunk line. It concentrates outward-bound packets and sends them to the packet network at 64k bps, and it directs incoming network packets to the correct local destination. A 68000 μP handles protocol processing. It features a 512k-byte

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Unretouched photograph
*3.5 NS max. rise & fall time measured at CRT cathode.

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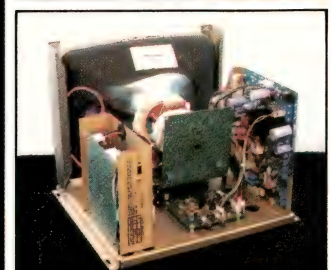
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The MS-CPU Series with 1 Megabyte dual ported RAM and 68881 Math Co-processor meets today's and tomorrow's performance requirements.

The new MS-CPU100 Series reduces board count by integrating key features such as no-wait-state dynamic RAM, ROM/EPROM sockets, two communication ports and a clock calendar. A system controller supporting multi-processing with a mail box interface rounds out the features of this highly integrated *VMEbus processor board*. And interface is EASY... the MS-CPU100 and MS-CPU110 are almost *entirely configurable under software control!*

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6U Format
for use in double-height systems

3U Format
shown with optional Math Accelerator

Available in 3U or 6U Formats

MS-CPU100/110 Features

- 1Meg/512K Dual Ported, *No-Wait-State* DRAM
- 12.5 MHz 68000/68010 with Optional 68881 Math Accelerator
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- (2) 28 Pin ROM/EPROM Sockets; 2K Battery Backed Static RAM
- Full VMEbus System Controller, Supports Multi-Processing
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CIRCLE NO 202

MATRIX CORPORATION
1203 New Hope Road • Raleigh, NC 27610 • Phone (919) 833-2000 • FAX (919) 833-2550

dynamic RAM for buffering and routing. The unit supports LAPB (link access protocol B); a password-protected network-management facility provides on-line status and statistics. You can link multiple units together via Ethernet segments to create a customer-premises network. $6500.

Advanced Computer Communications, 720 Santa Barbara St, Santa Barbara, CA 93101. Phone (805) 963-9431. TWX 910-334-4907.

Circle No 675

PC COPROCESSOR

The Leonardo add-in coprocessor board for the IBM PC/AT or compatibles provides you with five IMS-T414 or -T800 Transputers. The Transputers are linked in a pipe topology; each Transputer is linked to its immediate neighbor by two Transputer links. This topology leaves the Transputers at either end of the pipe with two Transputer links unconnected to the pipe. The master Transputer, at the head of the pipe, uses one of these links to communicate with the AT Bus via an Inmos link adapter and 2k bytes of dual-port RAM. This interface can transfer data between the coprocessor board and the AT Bus at 800k bytes/sec and can generate host interrupts. You can connect the remaining Transputer links at either end of the pipe to other Leonardo boards or to external systems.

The master Transputer comes with as much as 4M bytes of RAM, and each of the four slaves features 256k bytes of local RAM. The board runs Inmos Transputer development software; C, Pascal, Fortran, and Occam compilers; and the vendor's Pablo raster-to-vector encoding and decoding language for scanned graphics. Version with five T414 Transputers, 1M byte of master RAM, and 256k bytes of RAM for each slave, $6500.

Simulation Technology AS, Sandakerveien 35B, Torshov, 0401 Oslo 4, Norway. Phone (2) 156710.

Circle No 678

IMAGE SCANNER

The N-205 image scanner provides user-selectable resolution to 200 dots/in. and employs an image sensor that performs overhead scanning of documents. The unit adapts to ambient-light conditions. You don't have to obtain additional hardware in order to use it with Macintosh computers or with an IBM PC or compatible. It interfaces with your computer via an RS-232C port that has a switch-selectable 19,200-baud max data-transfer rate. You can also use its Centronics-compatible bidirectional parallel port to



CIRCLE NO 203

transfer data. The scanner's desktop-publishing software lets you input a scanned image, call it up on your terminal, edit it, and print it. You can purchase the unit with Front Page Personal Publisher, PC Paintbrush Plus, or optical-recognition software for use with the IBM PC or compatibles, or you can obtain it with Haba Personal Publisher software for use with the Macintosh. Scanner without software, $695.

Chinon America Inc, 6374 Arizona Circle, Los Angeles, CA 90045. Phone (213) 216-7611.

Circle No 676

GRAPHICS ADAPTER

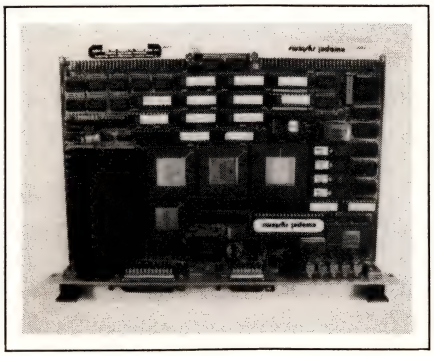
The SuperVGA HiRes VGA-compatible graphics-adapter board for the IBM PS/2 computer can simultaneously display 256 colors at 800×600-pixel resolution. You can obtain it with an optional 16-color 1024×768-pixel resolution mode. The board contains 512k bytes of video memory and can support an IBM 8514 monitor. It is compatible with the IBM BIOS VGA and automatic CGA or compatibles. It comes with connectors for analog and TTL/multifrequency monitoring. You can employ one of 10 text modes for spreadsheet and desktop-publishing applications. The unit is also compatible with the Hercules and IBM VGA, EGA, MCGA, CGA, and MDA standards. $695.

Genoa Systems Corp, 73 E Trimble Rd, San Jose, CA 95131. Phone (408) 432-9090. TLX 172319.

Circle No 677

BOARD COMPUTER

The Venus VME Bus-compatible single-board computer has a 68020 μP, 68881 math coprocessor, 68851 paged-memory-management unit, and 4M bytes (16M bytes optional) of RAM. Both the μP and the VME Bus have access to the dual-ported RAM. You can run Unix System V on the board. To prevent bottlenecks on the main CPU bus, a dedicated I/O processor controls all board I/O functions, such as graphics, audio, and clock/calendar functions, and SCSI, Ethernet, X.25, keyboard, and mouse interfaces. The board's VME Bus interface provides AM6/A32/A24 and D32/D16/D8 VME Bus operation in either master or slave modes. The VME Bus interface also includes interrupt-support and system-controller functions.



You can order the board as an OEM product with I/O software drivers and a debug monitor, or as a system-integration package with a Unix System V license and the Open-Top windowing system. The board is Sun NFS compatible, which permits you to share a virtual file system over a Sun NFS Ethernet LAN. The systems-integration package costs £4000.

Europel Systems, 5 Vo-Tec Centre, Hambridge Lane, Newbury, Berkshire RG14 5TN, UK. Phone (0635) 31074. TLX 848507.

Circle No 679

RAM BOARD

The FAB104 Multibus II-compatible memory board provides 4M bytes of parity-checked dynamic RAM. It supports 8-, 16-, 24-, and 32-bit data transfers, and 26-bit addressing on the iLBX-II bus. The read-access time is 375 nsec; the write-access time is 250 nsec. You can program board parameters—including base-address and refresh modes—via the Multibus II interconnect space, which the iLBX-II bus supports. One of the board's refresh modes is

ARE VME TIMING ERRORS LURKING IN YOUR DESIGN?

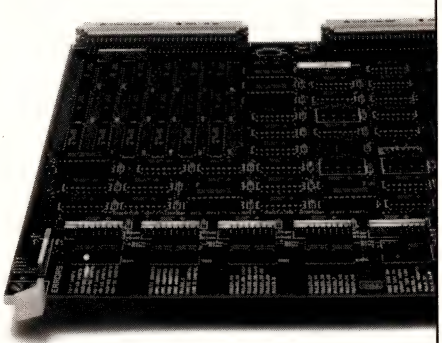
FIND OUT BEFORE OTHERS DO.

The VME Bus Anomaly Trigger (VBAT) is a massively parallel trigger board which automatically recognizes violations of the VME specification in real time.

Plug it into a spare slot in your system, and it will find design errors in all boards by watching every bus cycle, during actual operation.

Each timing violation lights an LED and generates a trigger output in less than 80 ns, which will trigger your logic analyzer, to give you an immediate picture of the bad bus activity.

Try one, and be confident.

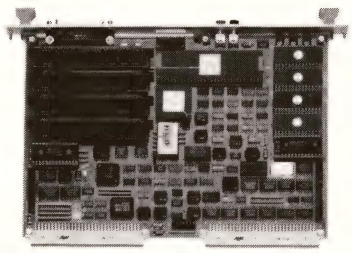


ULTRAVIEW

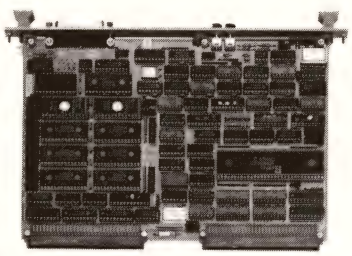
Ultraview Corporation
475 Yampa Way
Fremont, CA 94539
(415) 657-9501
FAX: (415) 657-0927

CIRCLE NO 204

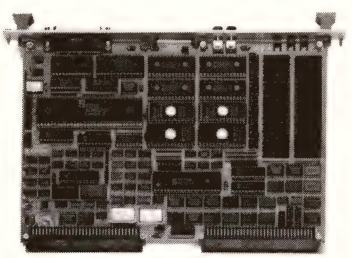
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TL Industries also offers contract manufacturing capabilities, including surface mount technology, custom design, and software services. Please call or write for more information.

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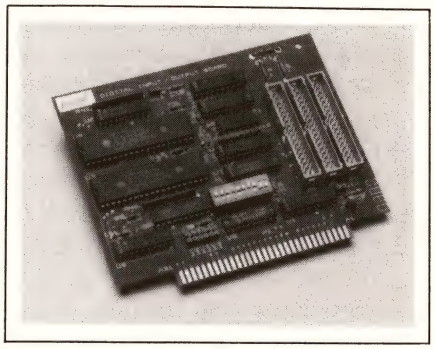
TL Industries, Inc.
2541 Tracy Rd.
Toledo, OH 43619
Call Meg Niehaus
1-800-227-8144 (outside Ohio)
or 419-666-8144
FAX 419-666-6534

292 CIRCLE NO 205

designed so that the board can acquire video information and support real-time image-processing operations. Typically, it draws 3.5A from a 5V supply. Fr 34,200.

Centralp Automatismes, 16 rue Gabriel Peri, 92120 Montrouge, France. Phone (1) 42533617. TLX 632380.

Circle No 680



DIGITAL I/O BOARD

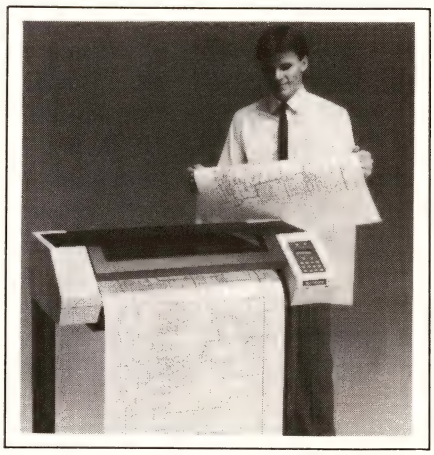
The PCI-20087W-1 digital I/O board plugs directly into an expansion slot of any IBM-compatible personal computer. The board has 40 digital I/O channels that accommodate TTL-compatible signals in 5 groups of 8 bits each. Each 8-bit byte is independently software programmable for use as either an input or output port. You can synchronize the data transfer on two of these ports to external hardware events by using the channels in the fifth port as handshake control lines. The board initializes all ports as inputs at power-on. The half-size card fits into the short slot of an IBM PC/XT, is compatible with industry-standard optoisolators, and comes with Basic language software drivers. Signal connections to the board are via standard ribbon-cable connectors. $165.

Burr-Brown, Box 11400, Tucson, AZ 85734. Phone (602) 746-1111. TLX 666491.

Circle No 681

8-PEN PLOTTER

The Artisan Model 1023 is an 8-pen plotter that produces high-resolution drawings on cut-sheet paper and film. The plotter can operate as fast as 30 in./sec. Addressable resolution is 0.005 inches, and accuracy is 0.1% of the distance moved or 0.01 inches, whichever is greater. Two dc-servo motors enhance throughput by providing fast pen positioning, and a look-ahead feature keeps the pen moving at high speed when a line changes direction by less than 45°.



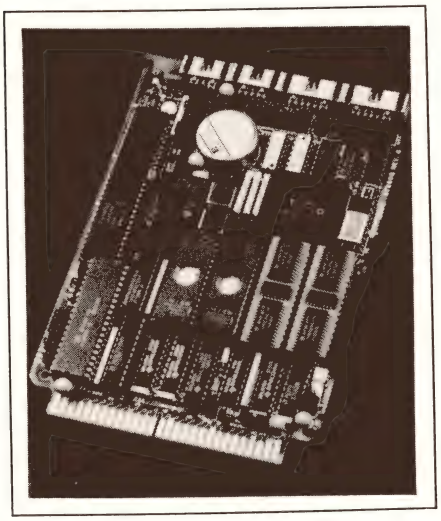
An optional 1M- or 2M-byte memory-expansion cartridge lets a user download entire plot files from the host computer. A rotating turret houses any combination of liquid ballpoint, fiber- and plastic-tip, and disposable-liquid-ink types of pens. Built-in optical sensors determine the selected pen, and circuitry automatically adjusts force, velocity, and acceleration parameters. An intelligent control panel, which includes a keypad and a 32-character LCD, guides the user. $4895.

Calcomp, Box 3250, Anaheim, CA 92803. Phone (714) 821-2142.

Circle No 682

V20 COMPUTER BOARDS

The ZT8808 (5 MHz) and the ZT 8809 (8 MHz) STD Bus single-board computers use a NEC V20 μP, a superset of the 8088. In addition to a wait-state generator, each board contains IBM PC/XT peripheral devices, including three 16-bit counter/timers, an interrupt controller, two serial ports, and a Centronics interface. The boards accommodate



256k bytes of RAM and 256k bytes of EPROM, or 384k bytes of RAM and 128k bytes of EPROM. For computational-intensive applications, you can add an 8087 math coprocessor via the SBC337 adaptor. Other features include ac/dc power-fail protection, optional battery backup for the timekeeper and the RAM, and direct 20-bit addressing of 1M bytes of memory. $595 (no RAM).

Ziatech Corp, 3433 Roberto Court, San Luis Obispo, CA 93401. Phone (805) 541-0488. FAX: (805) 541-5088.

Circle No 683

IMAGE PROCESSOR

Designed for use with IBM's PS/2 machines, the Series 151 allows users to perform real-time, high-performance image processing on IBM's Micro-Channel bus. You can choose from 11 functional boards—8 for pipeline image processing—to create a cost-effective system. The subsystem is housed in a self-contained chassis with either 7 or 12 slots for image-processing boards. A bus interface, requiring only one slot in both the subsystem's chassis and the PS/2, allows PS/2 Models 50, 60, and 80 to control all operations of the image processor.

The image processor captures images from both RS-170 and nonstandard video sensors such as line-area-scan cameras. Its capabilities include real-time averaging, subtraction, convolutions with programmable 8×8 kernels, histograms, feature extractions, binary correlation, morphology, and median filtering. The basic configuration



VME Dream Card

The HK68/V30 is the card you've been dreaming of.

This fully-loaded single-board VME microcomputer combines the highly sought-after qualities of high speed and advanced on-card functionality. Now you can have high-end performance for UNIX and real-time applications. Standard equipment:

▪ Up to 25 MHz Motorola 68030 CPU ▪ 4 or 16 MB of on-board DRAM with parity ▪ Up to 1 MB of EPROM ▪ 2 serial I/O ports ▪ Single 8-bit parallel port ▪ Mailbox interrupt support.

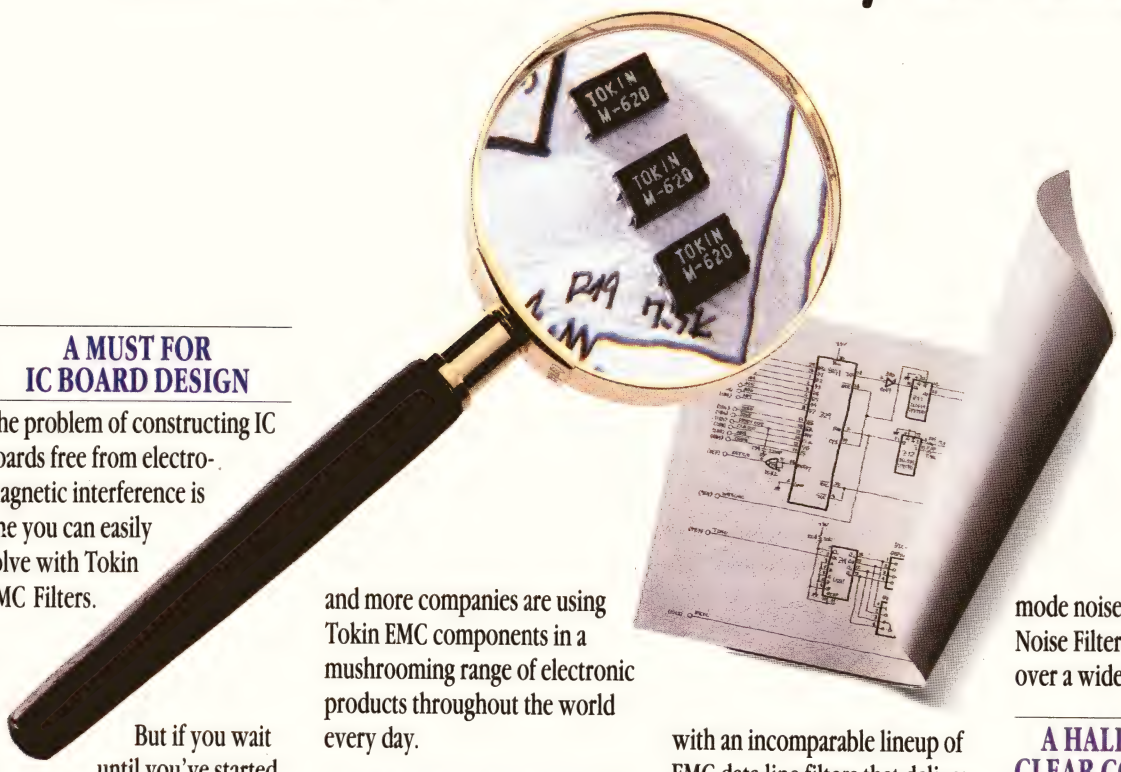
Optional equipment includes on-board 68881/68882 FPP, SCSI interface and Time-of-Day clock with battery back-up.

HEURIKON CORP.

Take Heurikon's HK68/V30 for a grand tour today.
Call toll-free: 800-356-9602 (ext. 503).
Telefax: 608-251-1076
3201 Latham Drive ▪ Madison, WI 53713

CIRCLE NO 206

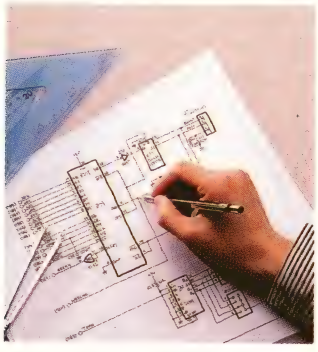
Eliminate the noise from your design.



A MUST FOR IC BOARD DESIGN

The problem of constructing IC boards free from electromagnetic interference is one you can easily solve with Tokin EMC Filters.

But if you wait until you've started designing the board, it's already too late; it's something you need to consider *before* you begin. The Tokin EMC Chip Filters above are a good example. By including them in the IC design from the start, the designer can create an IC board that enables the end user to enjoy the full, unrestricted potential of the board's performance. That's why more and more companies are using Tokin EMC components in a mushrooming range of electronic products throughout the world every day.



AN ANSWER FOR YOUR EVERY DIGITAL NEED



Digital electronics are changing the shape of the world we live in, in more ways than one. And to deal with EMI, the normal- and common-mode noise that attacks data communications terminals and digital equipment, Tokin has come to the rescue with an incomparable lineup of EMC data line filters that deliver clear, accurate data transmission. From easy-to-mount EMC Chip Filters for normal- and common-mode noise absorption, to DIP Noise Filters for high impedance over a wide frequency range.

Specifications (DIP Noise Filters)

Model	Circuit	Rated Current per Line (mA)
D-03C/ D-03C1	8 circuits; Common-mode	100
D-05N1	8 circuits; Normal-mode	100
D-07C1	8 circuits; Common-mode	300
D-08C2	4 circuits; Common-mode	2,300
D-08C2A	4 circuits; Common-mode	500
D-16C	4 circuits; Common-mode	100
D-20C	8 circuits; Common-mode	500
D-40C	3 circuits; Common-mode	300
D-42C	5 circuits; Common-mode	300
D-45C	8 circuits; Common-mode	300
D-47C	10 circuits; Common-mode	300
D-55C	5 circuits; Common-mode	300
D-58C	8 circuits; Common-mode	300

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Tokin stands for reliability you can count on, and all Tokin EMC components are backed by 50 years of intense work in developing and manufacturing communications and electronics materials and devices. From power line filters to noise simulators and other measuring equipment and facilities, Tokin offers a vast selection of products and services to provide unprecedented communication clarity. Call us for details.

Specifications (EMC Chip Filters)

Model	Circuit	Frequency Range (MHz)	Impedance (Ω)	Rated Current (mA)
M608	1 circuit; Common-mode	5~200	≧300 (at 100MHz)	100
M614	1 circuit; Common-mode	5~100	≧700 (at 50MHz)	100
M620	1 circuit; Common-mode	5~50	≧1,000 (at 30MHz)	100
M720N	20 circuits; Normal-mode	50~300	≧50 (at 200MHz)	50

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Tokin Corporation
Head Office: Hazama Bldg., 5-8, Ni-chome, Kita-Aoyama, Minato-ku, Tokyo 107, Japan **Tel:** Tokyo (03) 402-6166 **Fax:** Tokyo (03) 497-9756
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includes a 7-slot chassis, three real-time image processing boards, and a PS/2 interface. $11,495; delivery, 90 days ARO.

Image Technology Inc, 600 W Cummings Park, Woburn, MA 01801. Phone (617) 938-8444. TLX 948263.

Circle No 684



TAPE SUBSYSTEM

The Bridge-Tape subsystem provides 42M bytes of tape-backup capacity and the necessary software to back up all Novell, 3COM, and PC-Net networks. The 3.5-in. tape cartridge works with IBM PS/2, PC/XT, and PC/AT computers; it connects to the PS/2 via an adapter card that plugs into the computer. The unit contains 24 tracks of data. A dual-gap configuration lets the ceramic read/write head use dedicated channels. The transfer rate of 250k or 500k bytes/sec defaults automatically to the fastest available. A menu-driven program simplifies subsystem installation, and you can access on-line help screens with one keystroke. $695 for the drive, and $70 for the host adapter card.

Sysgen Inc, 556 Gibralter Dr, Milpitas, CA 95035. Phone (800) 821-2151; in CA, (408) 263-4411.

Circle No 685

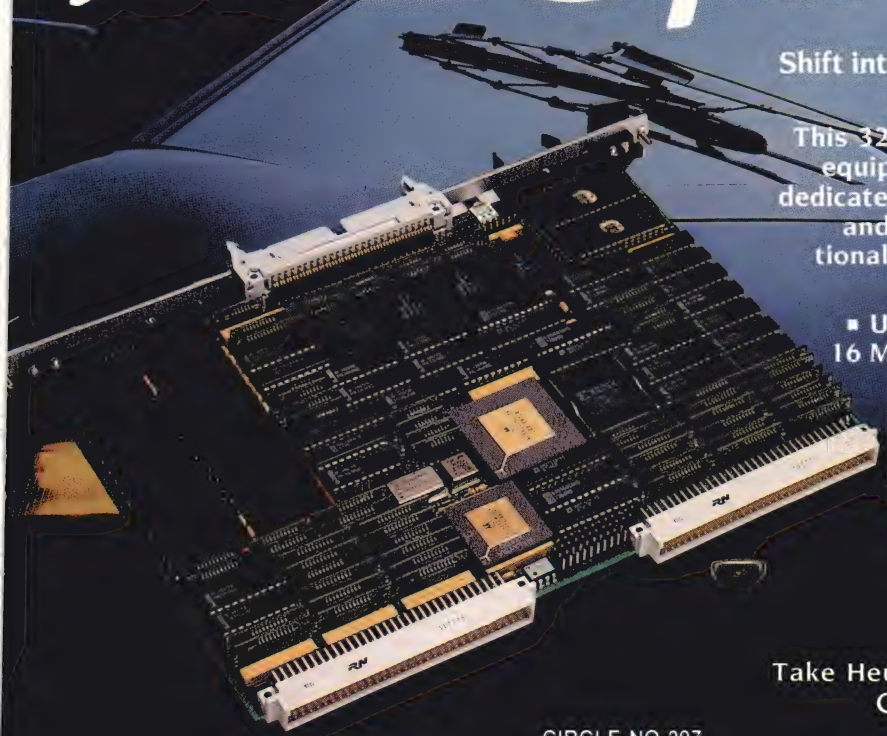
COLOR FRAME GRABBER

The DT2871 color frame-grabber board incorporates a proprietary HSI (hue-saturation-intensity) chip set that simplifies high-speed, color image processing on IBM PC/ATs and compatibles. The chip set enables the color frame grabber to capture real-life color images from a color video camera and convert them on-the-fly from mixtures of red, green, and blue to values representing hue, saturation, and intensity. The board produces HSI values in real time at the rate of 30 frames/second. Unlike graphics boards, which generate color images, the board captures, processes, and displays color images from color video sources. Captured images have 512×512-pixel resolution, and each pixel can represent one of 16,777,216 displayable colors. Optionally, the frame grabber can connect to the company's DT7020 floating-point array processor or its DT2528 frame processor. $2995.

Data Translation, 100 Locke Dr, Marlboro, MA 01752. Phone (617) 481-3700. TLX 951646.

Circle No 686

VME Sports Card



Shift into high gear with the high-performance, quick-handling VME HK68/V2E card.

This 32-bit single-board microcomputer is well-equipped to handle even the most challenging dedicated control tasks. Now you can have speed and versatility without sacrificing the functionality you need for sophisticated real-time applications. Standard equipment:

▪ Up to 25 MHz Motorola 68020 CPU ▪ 4 or 16 MB of on-board DRAM with parity ▪ Up to 2 MB of EPROM ▪ VSB compatible high speed memory expansion bus ▪ 4 serial I/O ports ▪ Single 8-bit parallel port.

Optional racy features include on-board 68881/68882 FPP and SCSI interface.

HEURIKON CORP

Take Heurikon's HK68/V2E for a trial run today.
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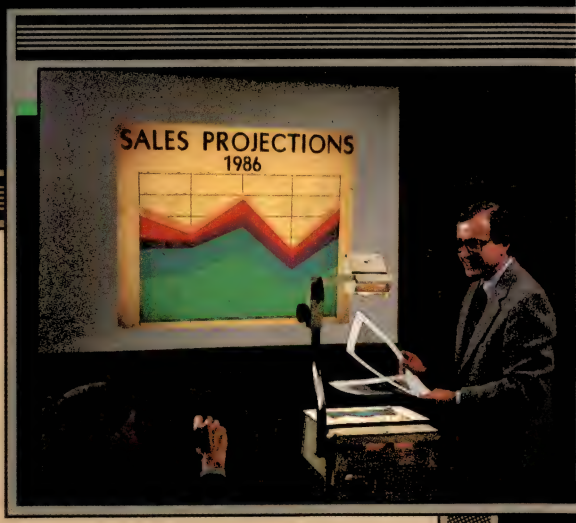
CIRCLE NO 207

TEK 4200 SERIES TERMINALS

WHY TEK BUILDS A BETTER GRAPHICS TERMINAL FOR IBM AND DEC THAN IBM AND DEC.



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The terminals of most mainframe builders are little more than slaves to the host. But Tek's 4200 Series gives you local manipulation, powerful graphics, and the option to use any host you choose.

Only the 4200 Series offers up to 1.5 MB of memory, with the local capabilities that let you use your host most efficiently.

Only the 4200 Series offers dual connection to both IBM and DEC and other ASCII hosts. You can work with up to six databases concurrently.

Only the 4200 Series delivers interactive true zoom and pan with the other superb graphic and alphanumeric features made famous by Tektronix.

Tek Software and peripheral compatibility is without equal in the graphics industry. The 4200 Series is supported by more than 175 world-class software vendors offering a full range of solutions for MIS, manufacturing and engineering.

To bring your applications to life, you can use the 4200-compatible 4690 Family of color printers. Or other popular monochrome and color output devices.

4200 Series are immediately available from authorized distributors or by contacting your local Tektronix representative. For information:
call 1-800-225-5434.
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Comparison of Graphics Terminals

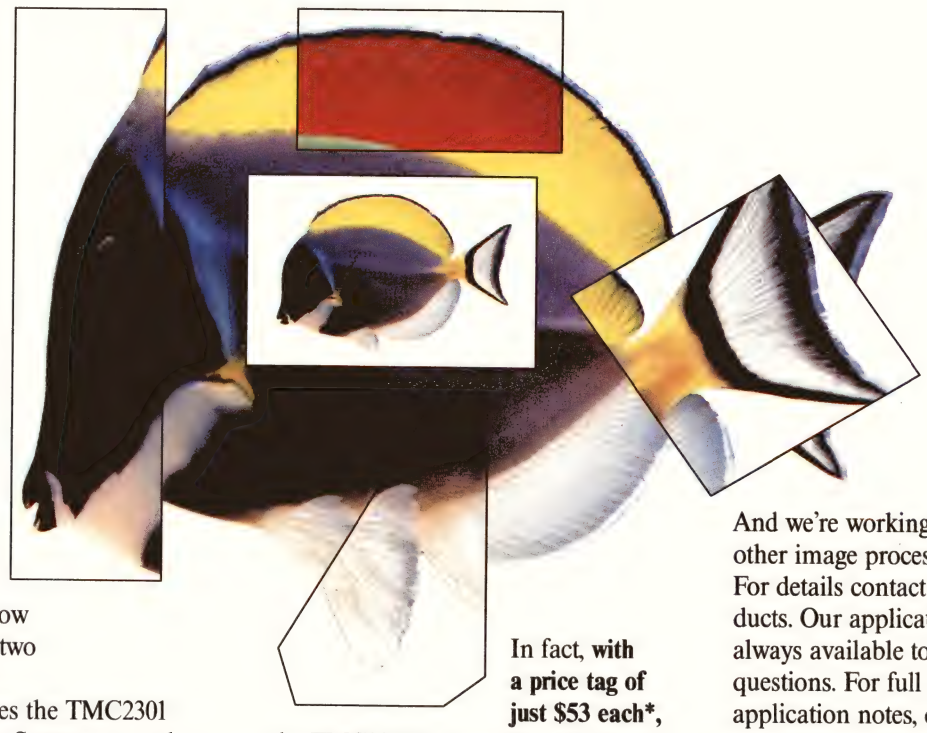
	TEK	DEC	IBM
DEC Host Compatible	Yes	Yes	No
IBM Host Compatible	Yes	No	Yes
Multiple Active Sessions	Yes	Yes	No
Tek 4010-4100 Command Set	Yes	No	No
Segments	Yes	No	No
True Zoom and Pan	Yes	No	No
IBM GDDM (Graphical Data Display Manager) Support	Yes	No	Yes
Graphics Addressability of 4096 × 4096	Yes	No	No
VT200 Alphanumerics	Yes	Yes	No
Background Hardcopy	Yes	No	No
Separate Graphics and Alphanumeric Regions	Yes	No	Yes

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CIRCLE NO 209

1988



Product Database Index

(November 1987 through April 1988)

Including products from EDN and EDN News

About this database . . .



This database lists products that received editorial coverage in EDN and EDN News between November 1987 and April 1988. EDN's products include those featured in Product Updates, showcases, and individual short-product sections. The products from EDN News include those from the New Products and Product Features sections.

You'll find products in eight main groups:
Components
Computers and Peripherals
Computer-Aided Engineering
Hardware and Interconnect
ICs and Semiconductors
Power Sources
Software
Test and Measurement Instruments

For more information about the products in the Index, use the addresses in EDN and EDN News to contact the manufacturers directly.

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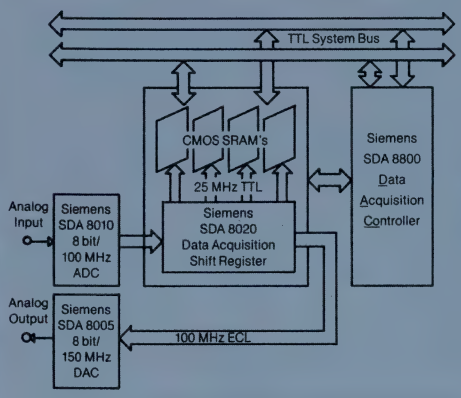
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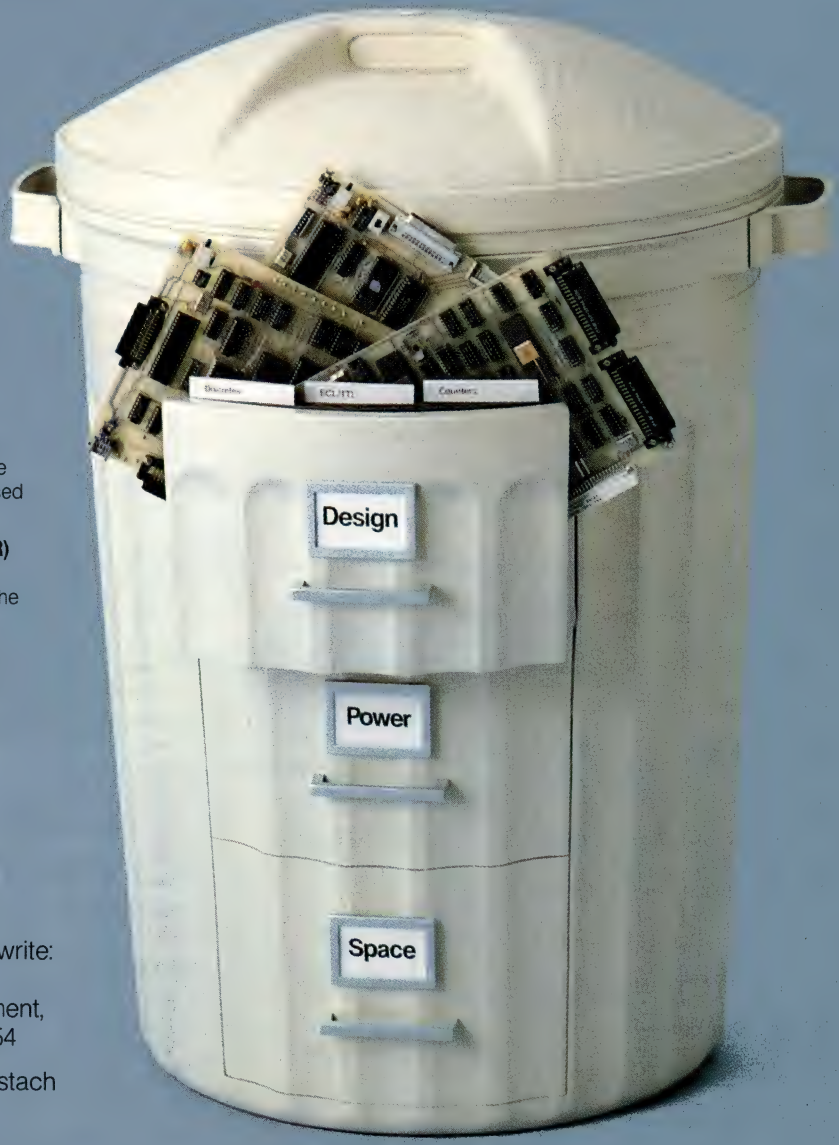
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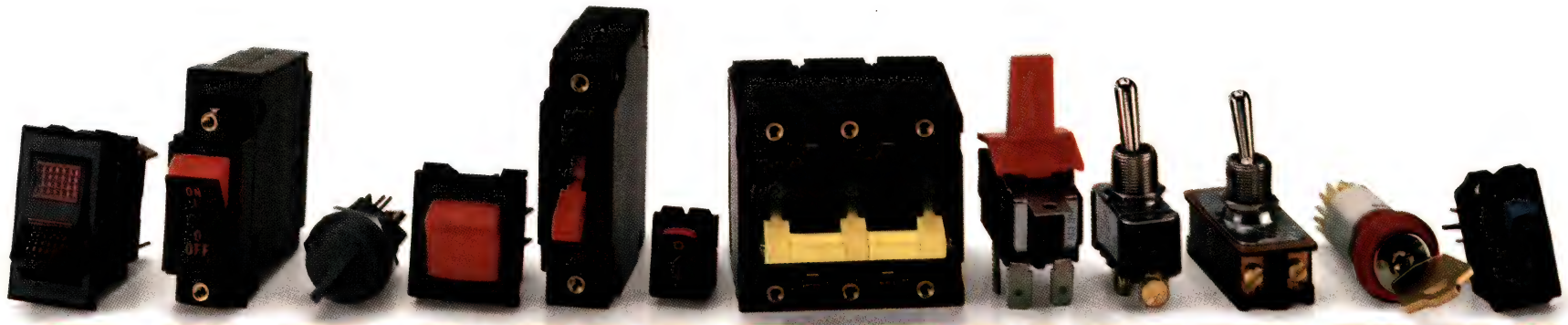
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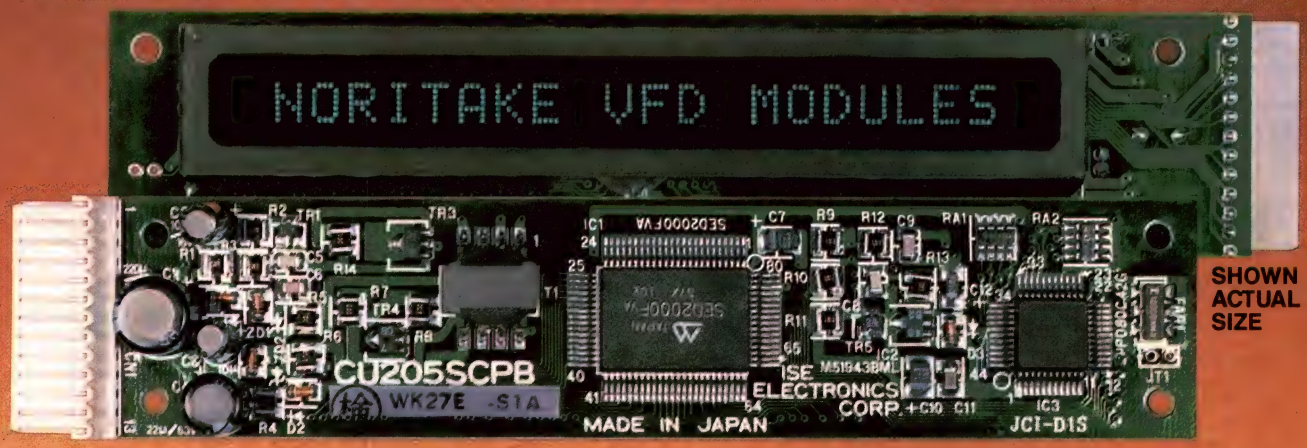
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								ROM	RAM
SCPB	14-SEGMENT + COMMA +D.P.	FU169SCPB-S1A	1 X 16	9.4	S/P	X	X		
		FU209SCPB-S1A	1 X 20	9.0	S/P	X	X		
	5 x 7 DOT MATRIX	CU205SCPB-S1A	1 X 20	5.0	S/P		X		1
	5 x 7 DOT MATRIX + CURSOR	CU20026SCPB -S20A	2 X 20	5.0	P	X	X		5
		CU40026SCPB -S20A	2 X 40	5.0	P	X	X		2
MCPB	5 x 7 DOT MATRIX + CURSOR	CU406MCPB -S1A; -S31A	1 X 40	5.0	S/P	X	X	X (-S31A)	8
		CU20026MCPB -S1A; -S31A	2 X 20	5.0	S/P	X	X	X (-S31A)	8
		CU40026MCPB -S1A; -S31A	2 X 40	5.0	S/P	X	X	X (-S31A)	4

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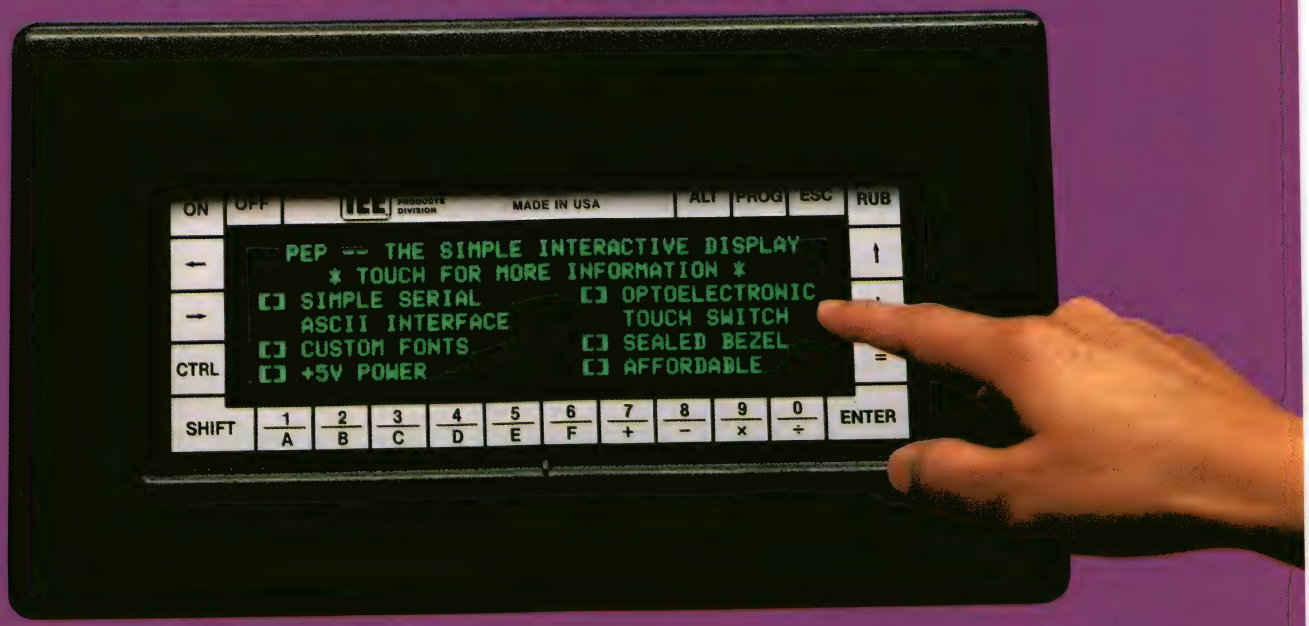
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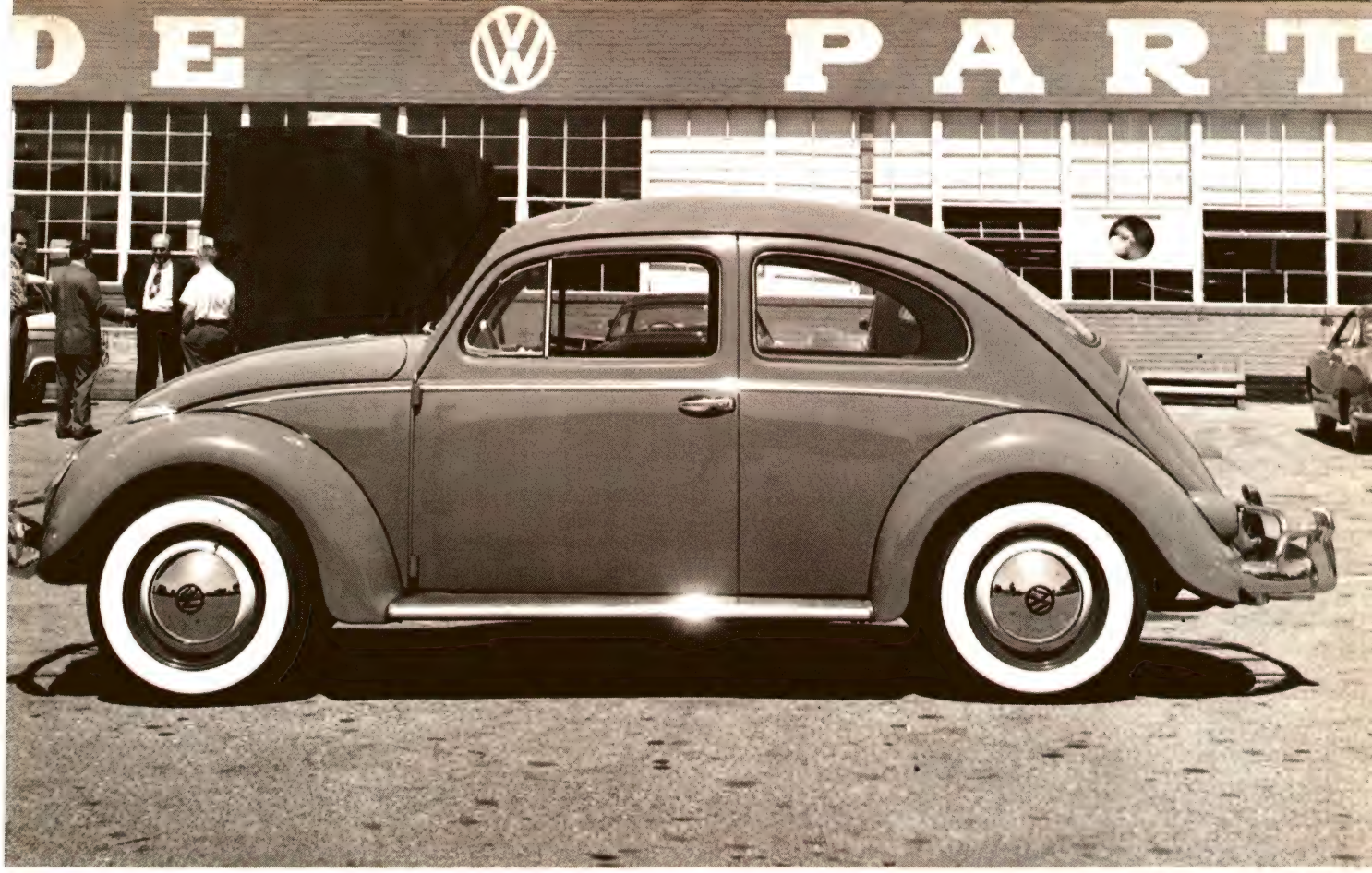
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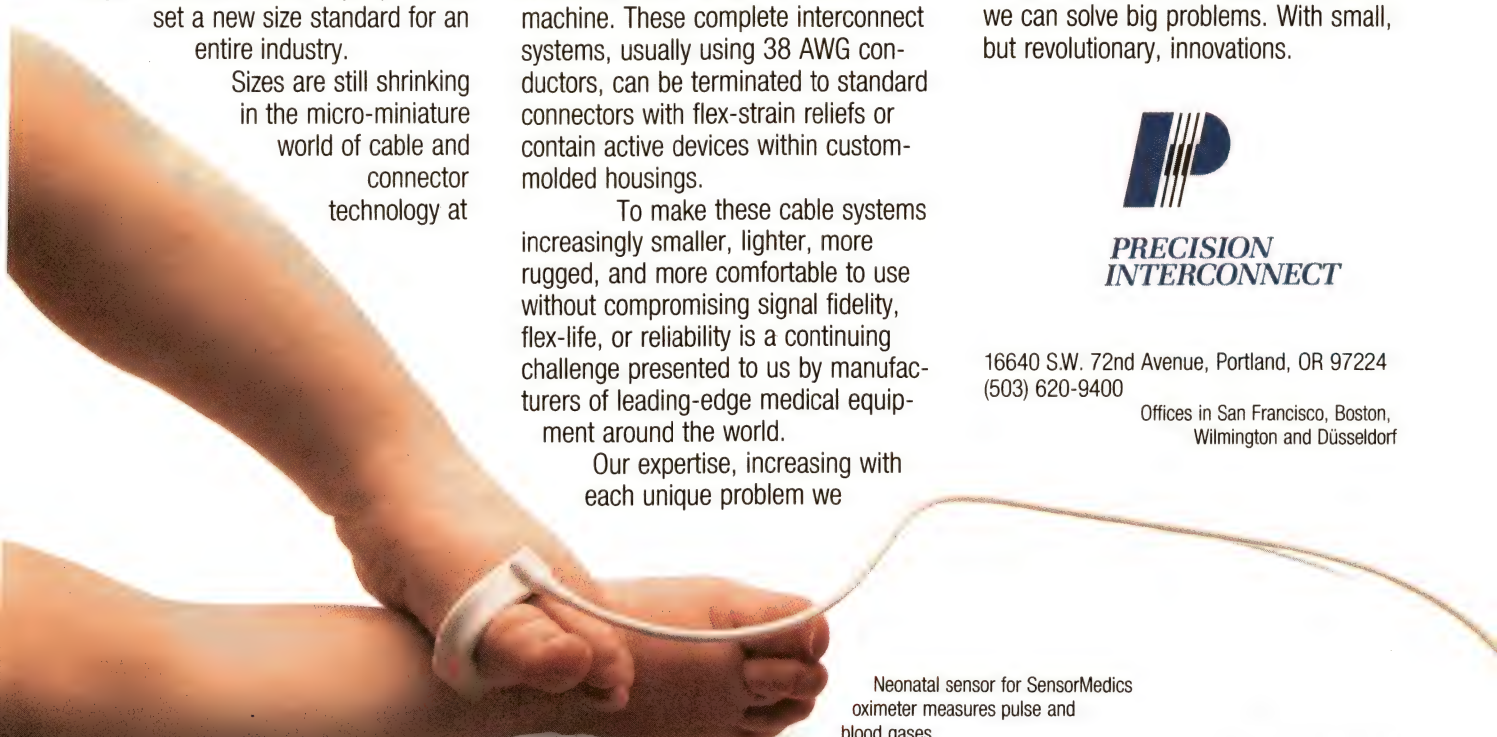
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When speed is of the essence, our customers appreciate our ability to produce in volume a whole family of very fast devices using advanced 1.2 and 0.7 micron processes.

When it's low power consumption that's required, MHS also has a proven track record in such fields as military and space, or portable PCs and instruments. Our engineers have reinvented the art of making six-transistor-per-cell memories, with fine processes allowing very low stand-by currents, radiation tolerance, as well as protection against latch-up, ESD and soft errors.

Fast

Format	Part-number	Access time (ns) @70°C	@125°C
16 k x 1	65767	15-45	25-45
4 k x 4	65768	15-45	25-45
2 k x 8	65728	25-55	35-55
8 k x 8	65764	35-55	45-55
16 k x 4	65788-91	25-45	35-45
64 k x 1	65787	25-45	35-45
8 k x 9	65779	35-55	45-55

Stand-by currents : 5 to 30 mA

Very low-power

Format	Part number	ICC sb1 (µA) @70°C	@125°C
16 k x 1	65262	1-100	50-500
2 k x 8	65162	1-100	50-500
8 k x 8	65641	1-100	50-500

Access time : 55 to 85 ns
ICC dr@2 V = 40 % of ICC sb 1

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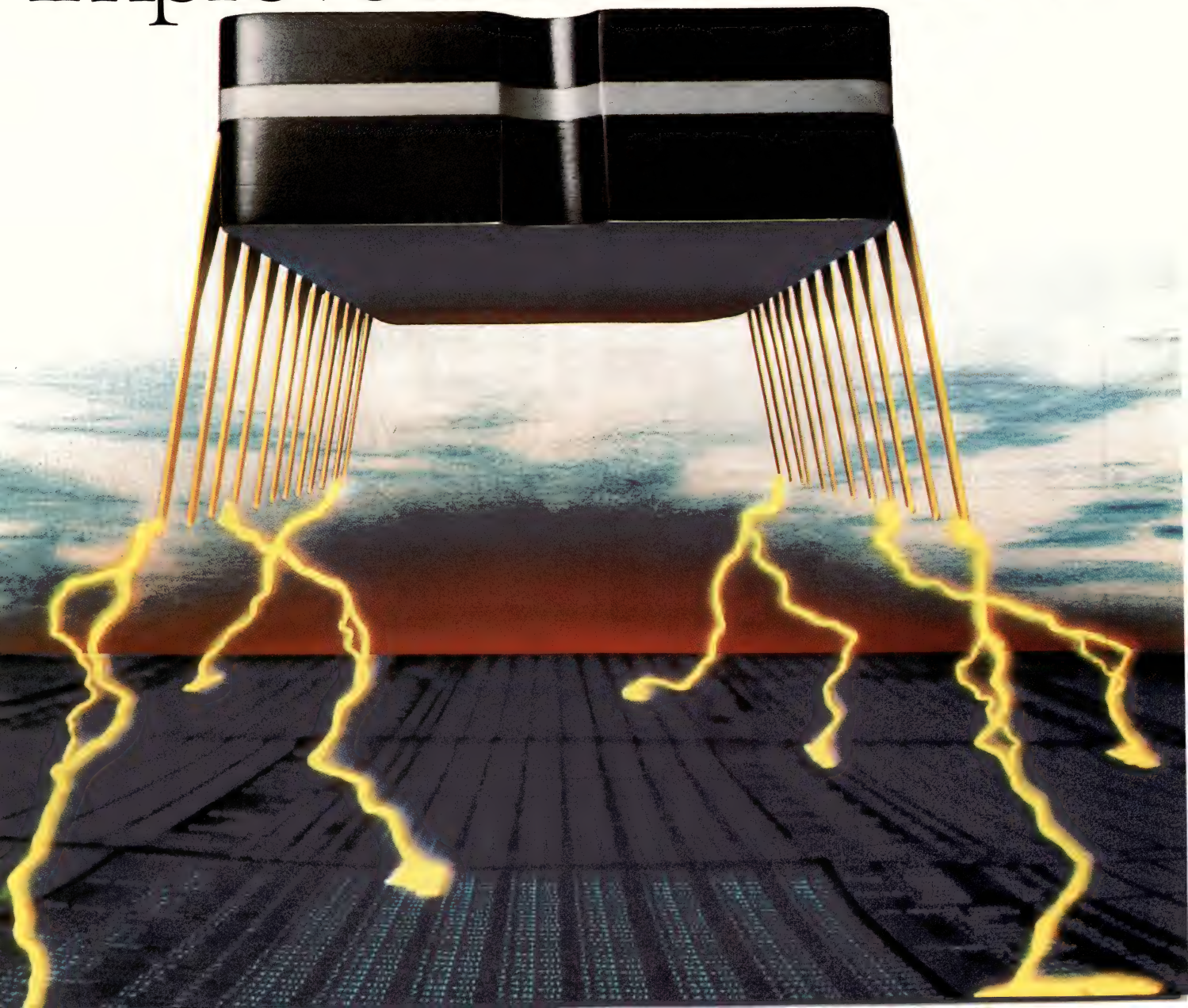
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Avocet Systems Inc, *8748 MPU*, EDN, 3/03/88, pg 198



CIRCLE NO 218



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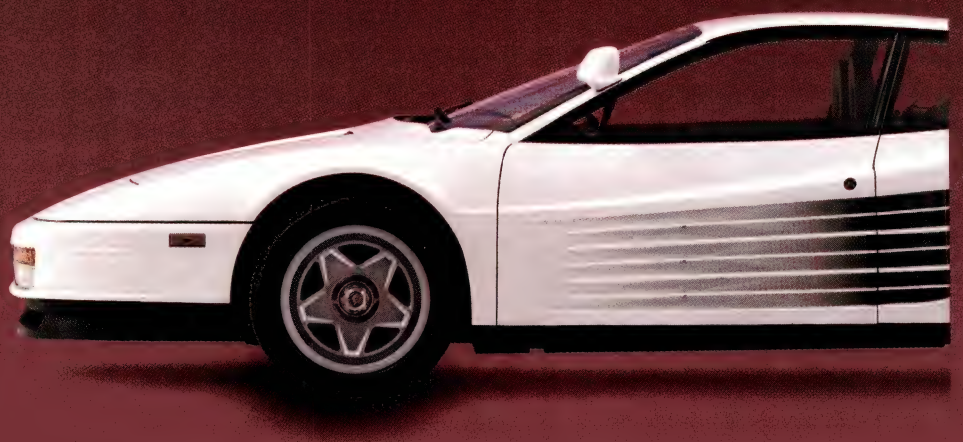
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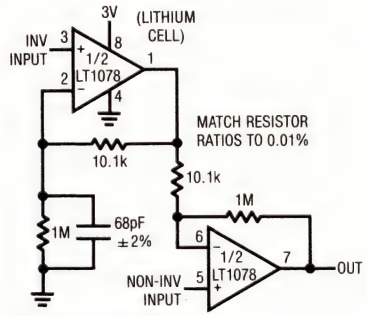
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= 300μV_{RMS} OVER FULL BANDWIDTH
INPUT RANGE = 0.03V TO 1.8V
OUTPUT RANGE = 0.03V TO 2.3V (0.3mV ≤ V_{IN} ≤ 23mV)
OUTPUTS SINK CURRENT — NO PULL DOWN RESISTORS ARE NEEDED

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CIRCLE NO 220

EDITED BY TARLTON FLEMING

Time-delay relay has quick release

John A Haase
Colorado State University, Fort Collins, CO

The relay circuit of **Fig 1** provides a fixed time delay and fast release that is useful in monitoring slow-actuating events such as the response of a temperature sensor. For the component values shown, the delay (t_D) between the closure of S_1 to its NO contact and the closure of the output's NO contact is 8 sec. These output contacts release within a few milliseconds when S_1 returns to the NC position. The circuit also features low power consumption and compensates for line-voltage variations.

The full-wave rectifier, consisting of C_3, D_4, and D_5, supplies approximately 19V for operating the circuit. C_1, D_1, C_2, and D_2 form a charge pump when S_1 closes to the NO contact. Each line cycle then transfers charge from C_1 to C_2, producing a positive-going staircase voltage at the anode of Q_1, a programmable unijunction thyristor. (Substituting a diac for Q_1 is unsatisfactory because of the component tolerances and line-voltage dependence associated with such a device.) When the staircase voltage approaches Q_1's gate voltage (19V), Q_1 conducts, allowing C_2 to supply a surge of turn-on current to the relay, K_1. D_3 reinforces this action and prolongs the dropout time.

The current through R_4 and S_1 latches the relay on. R_4 sets this holding current at a conservative 50% of the relay's rated operating value, allowing the armature to remain in place without chattering. The voltage at C_3 then subsides to an equilibrium value (3V), whereby the charging current via D_2 equals the discharge current via Q_1. This equilibrium current is approximately 4× the "valley current" specified for Q_1, which allows the thyristor to remain in conduction at the reduced anode voltage.

When S_1 returns to the NC position, C_2 discharges through R_1, turning off Q_1 and allowing K_1 to de-energize. Note that the turn-on condition for Q_1 depends on the ratio of its gate and anode voltages. Because these voltages are proportional to the line voltage, line variations have little effect on the relay's delay time—less than 1% for ±10% changes in the 115V ac line. **EDN**

To Vote For This Design, Circle No 747

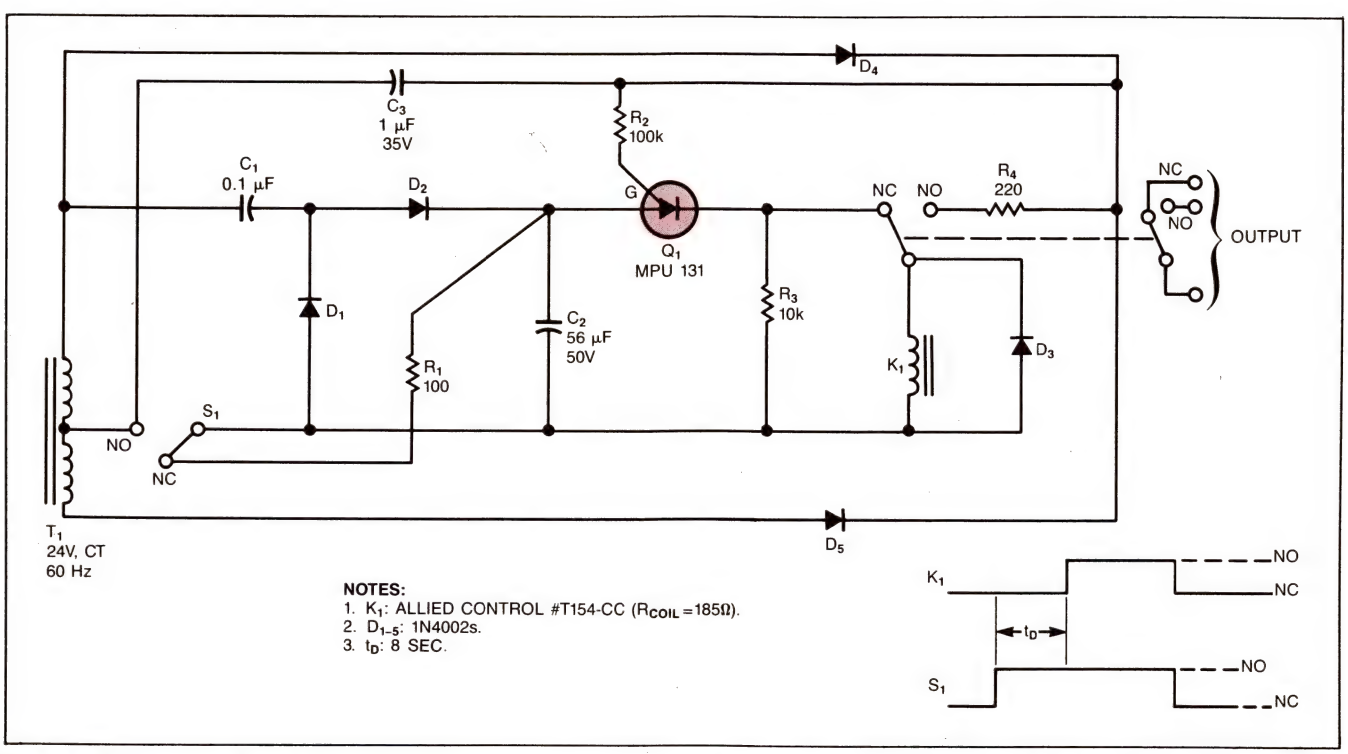


***Fig 1—This time-delay relay circuit** provides an 8-sec delay following S_1's closure to the NO position, but it de-activates promptly when S_1 returns to the NC position.*

Process-signal monitor ignores transients

Ronald Okupski
Mennen Medical Inc, Clarence, NY

The **Fig 1** circuit produces a contact closure in response to digital events produced by temperature controllers, motion detectors, fluid sensors, and other types of process-monitoring equipment. For applications such as these, the circuit provides jumper-programmable on and off delays that prevent chatter in the output relay. Otherwise, in a fluid-sensing application, for instance, small splashes on the surface of a fluid can produce multiple false signals.

Connect the jumper at IC_2's output according to the desired on-delay time between low-to-high input transitions and the closure of the output contacts. IC_3 provides a corresponding programmable off-delay interval. The circuit ignores further transitions during these intervals because each positive transition resets IC_3, and each negative transition resets IC_2.

For the jumper positions shown in **Fig 1** and for a 60-Hz clock signal, the on-delay time is

$$t_{ON}=\frac{0.5(2^8)}{60}=2.13 \text{ SEC},$$

and the off-delay time is

$$t_{OFF}=\frac{0.5(2^6)}{60}=0.53 \text{ SEC}.$$

The maximum on or off delay using CD4040 counters and a 60-Hz clock is 34.13 sec. When one counter is reset, the other continues counting; it also may count up and roll over repeatedly. This action doesn't cause a problem because the IC_{1B}/IC_{1D} RS flip-flop cannot change its output state until the opposite input changes state. **EDN**

To Vote For This Design, Circle No 749

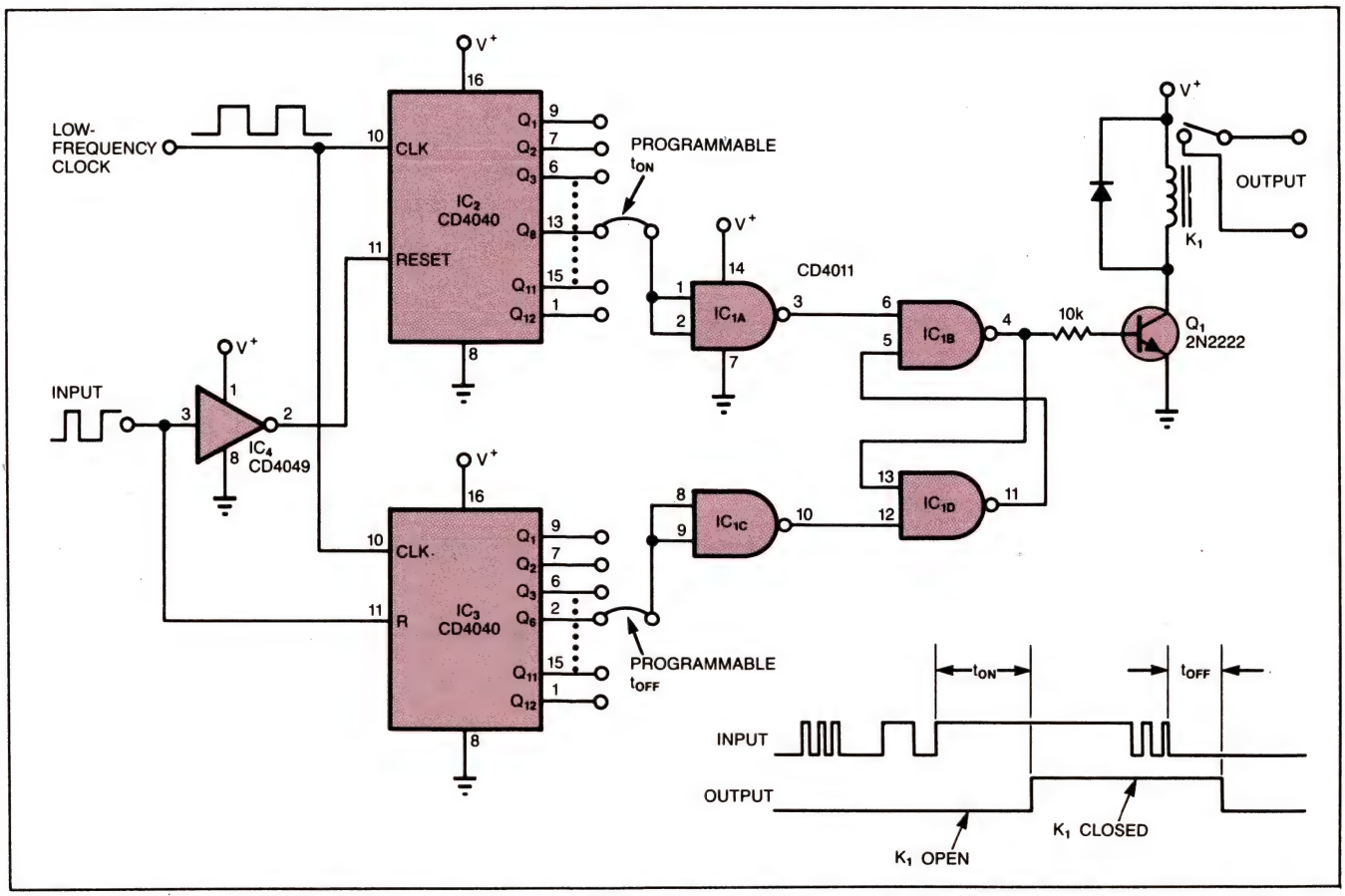


Fig 1—Jumper-programmable on and off delays *allow this monitor circuit to ignore digital chatter at its input.*

Compensate op amps without capacitors

Glenn DeMichele
Harris Semiconductor, Wooddale, IL

An uncompensated op amp operating at a low closed-loop gain usually requires one or more external components for stabilization. Conventional compensation techniques, which involve shifting the op amp's dominant pole or introducing an additional pole and zero, require the use of an external capacitor. Not only do capacitors take up space and introduce TC errors, but the phase and gain margins of these externally compensated circuits depend on the closed-loop-gain value. If you change the gain, you must change the capacitor value to re-optimize the circuit's gain-bandwidth product.

It's possible to provide compensation for an op amp in any forward-gain configuration without having to use a capacitor. **Fig 1** shows the most general case. This approach stabilizes the amplifier at higher frequencies by sacrificing some loop gain at dc and the lower frequencies. Phase and gain margins are independent of the closed-loop gain. The amplifier's input offset voltage, noise, and settling time, however, increase by a factor equal to the amplifier's noise gain (the signal gain from the noninverting input to output). The forward (closed-loop) gain, A_{CL}, is

$$A_{CL}=\frac{R_2}{R_1+R_2}\left(\frac{R_5}{R_4}+\frac{R_5}{R_3}+1\right)-\frac{R_5}{R_3}.$$

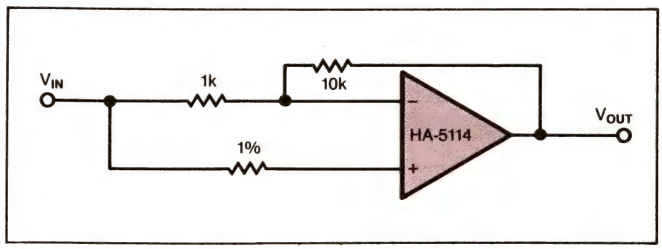


***Fig 2—A modified Fig 1** provides a noninverting, unity-gain configuration for an op amp that must operate normally with a minimum gain of 10.*

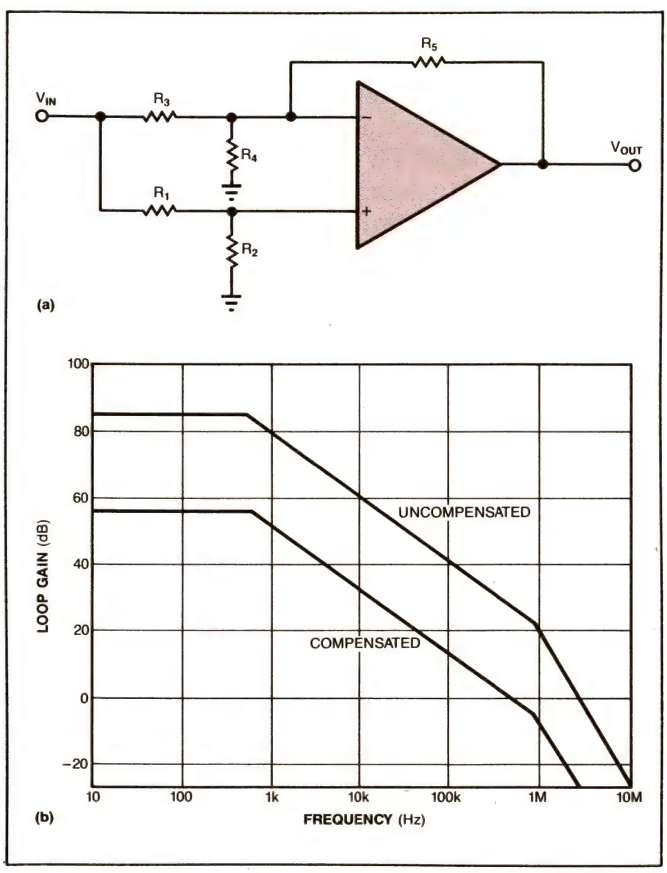


***Fig 1—A generalized, capacitor-free feedback network** lets you configure an uncompensated op amp for any forward gain.*

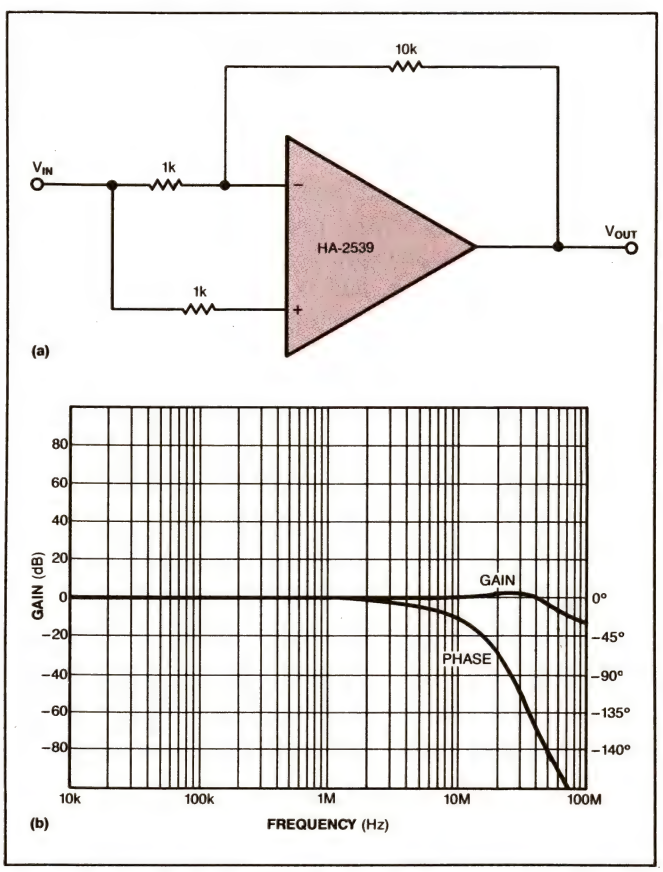


***Fig 3—Similar to Fig 2,** this unity-gain buffer is based on a 600-MHz uncompensated op amp.*

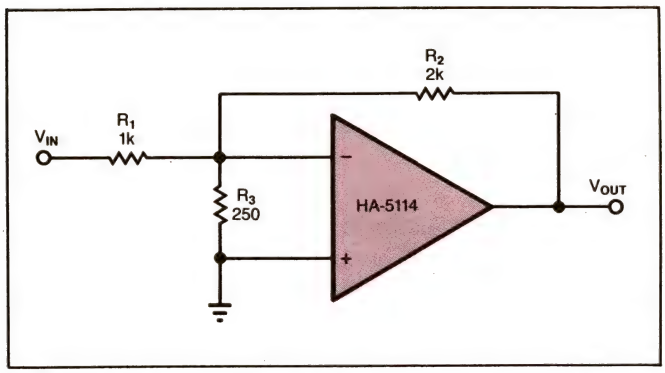


***Fig 4—In this circuit, three precision resistors** enable an uncompensated op amp to produce a gain of −2.*

For stability, ($R_5/R_4+R_5/R_3$) should be equal to or greater than the minimum stable gain specified for the op amp. R_1 and R_2 allow you to set arbitrary forward gains by applying a portion of the input signal as a common-mode voltage. R_3, R_4, and R_5 prevent oscillation by reducing the feedback factor.

The HA-5114 operational amplifier serves as a good example. This high-speed, low-noise, quad op amp normally requires a minimum closed-loop gain of 10. By adding three resistors, you can operate the device in the noninverting unity-gain mode (**Fig 2**). Again, note that the noise gain (11 in this case), causes 11× the noise and input offset voltage you would expect to find in a conventional unity-gain configuration. Resistive compensation doesn't degrade the slew rate, however. In **Fig 3,** the same connection results in a 45-MHz unity-gain buffer with a 500-V/μsec slew rate, based on a 600-MHz op amp.

Fig 4 shows the HA-5114 in a gain-of-−2 connection. R_1 and R_2 set the gain in the conventional way, and R_3 ensures that the op amp sees a minimum attenuation of 10 from the output to the inverting input. **EDN**

To Vote For This Design, Circle No 746

Signal activates battery-powered circuit

Robert A Bonetti
Tru-Data Systems, Rochester, MI

Fig 1 shows a signal-conditioning amplifier that applies power to itself only in the presence of a signal. The circuit extends battery life by drawing current only during battery testing, and is suitable for measuring engine speed or ignition timing. You can't lose data by forgetting to turn the power on, and you can't run the batteries down by forgetting to turn the power off.

In such an application, you first position the inductive sensor to pick up signals (with minimum 1.5V amplitudes) from the spark plug wires. Successive pulses charge C_1 until MOSFET Q_1 turns on. The high impedance of Q_1's gate minimizes sensor loading, and the capacitor's charge allows the circuit to remain on during the intervals between pulses. R_1 discharges the capacitor when the pulses cease, turning off V_{CC} in about 1 sec. **EDN**

To Vote For This Design, Circle No 750

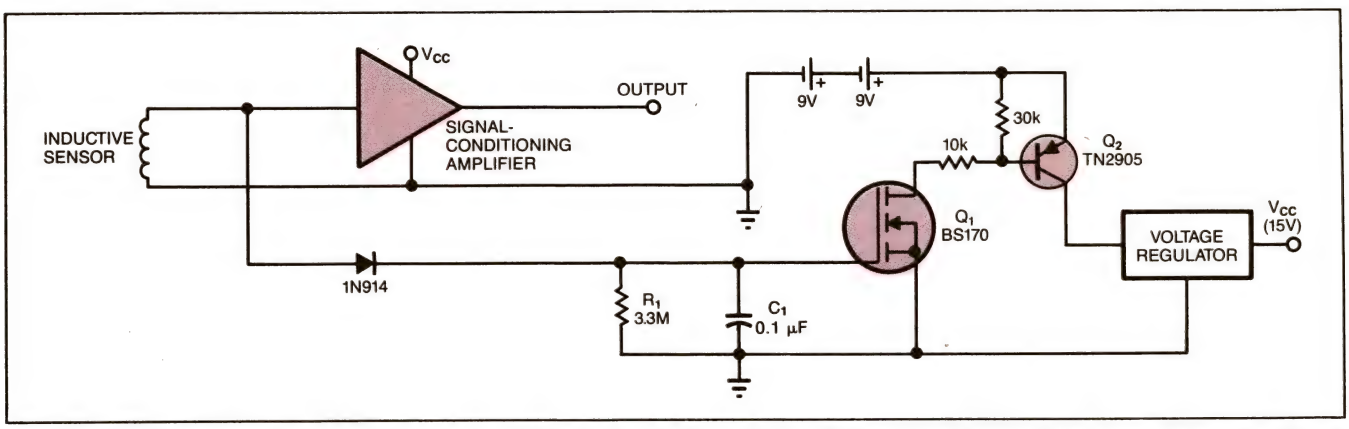


***Fig 1—Sensor signals activate this circuit,** which then activates the signal-conditioning amplifier by deriving V_{CC} from the batteries. Q_1 and Q_2 turn off when the signals cease, eliminating battery drain.*

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Battery-sense circuit deactivates quickly

Charles J Kopinski
American Monarch Corp, Minneapolis, MN

The sensing circuit of **Fig 1** rapidly disconnects the battery voltage and load whenever the voltage drops below a preset threshold. One-way operation prevents the circuit from reconnecting the load if the voltage should then rise above the threshold. C_1 ensures that the circuit doesn't activate while you're making connections to the battery; if you accidently reverse these connections, D_1 will block the turn on of the relay.

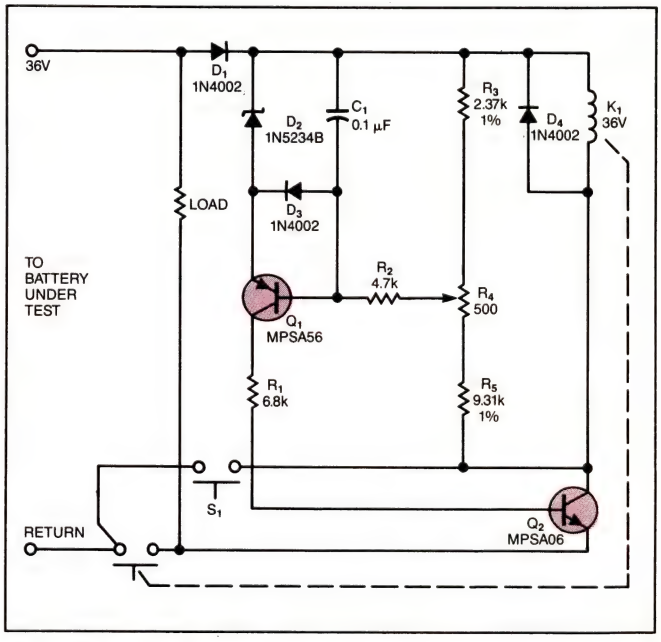
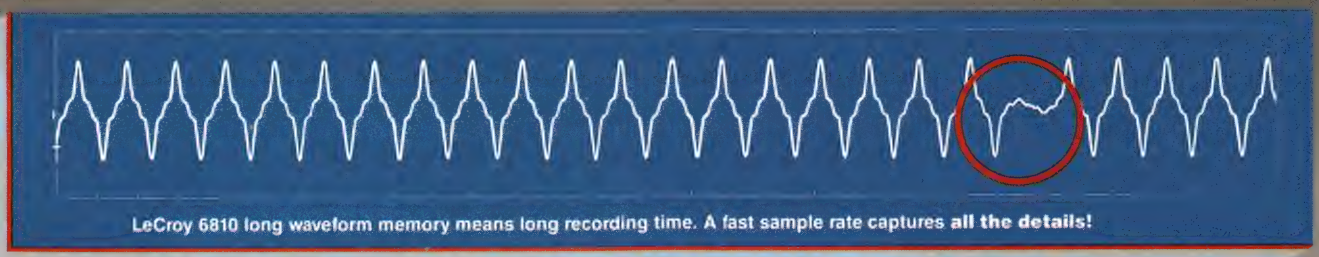


Fig 1—To use this battery tester, *connect the battery, press S_1, and increase the load. The circuit will disconnect the load when the battery voltage drops below the threshold you have preset using R_4.*

After you connect the battery, nothing happens until you depress the pushbutton switch (S_1), which allows the relay, K_1, to energize. When you release S_1, the relay remains on only if the battery voltage is above the minimum level. You preset this threshold—to 31.5V when testing 36V batteries, for example—using R_4. Q_1 begins to turn off as the battery voltage drops. Once the threshold level is reached, Q_2 also begins to turn off, and its rising collector voltage provides positive feedback to the base of Q_1, accelerating the turn off. When Q_2 turns off, the relay drops out, disconnecting the battery from its load. **EDN**

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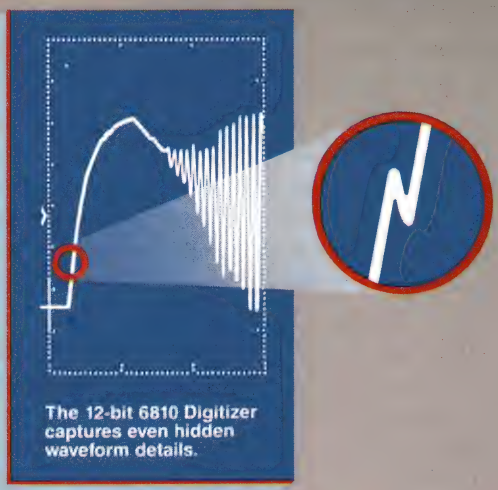
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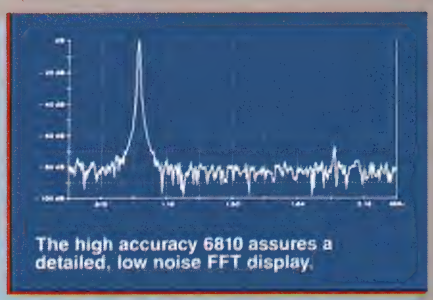
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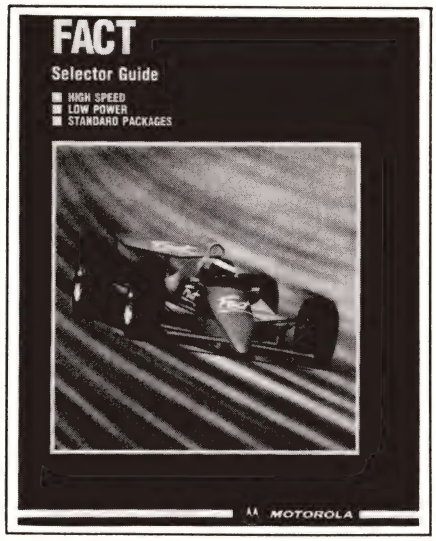
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Guide helps you select logic ICs

The vendor's 8-pg *Fact Selector Guide* describes Fact CMOS logic ICs and provides information about CMOS logic surface-mount technology. Its chart of logic-family comparisons allows you to compare and select standard logic elements. The guide also provides a numeric listing that presents the latest devices.

Motorola Inc, Literature Distribution Center, Box 20912, Phoenix, AZ 85036.

Circle No 751



Handy reference comes on floppy disk

The *Precision Decisions* catalog presents the vendor's complete line of analog signal-conditioning and data-conversion ICs. It comes on a 5¼-in., IBM PC-compatible floppy disk. This menu-driven catalog helps you make selections using a parametric spec search—the software searches for the vendor's parts within a specified product category. If the search yields no specified devices, the program expands the search by 10% increments. An additional catalog feature provides cross-referencing that indicates whether a device is a pin-for-pin replacement or an updated model.

Precision Monolithics Inc, Box 58020, Santa Clara, CA 95052.

Circle No 752

Brochure describes MMIC and digital IC products

This publication presents the vendor's full line of MMICs (monolithic microwave ICs) and digital ICs. It includes GaAs analog MMICs, GaAs prescalers, GaAs digital logic elements, and GaAs fiber-optic ICs. The publication also provides a selection guide, packaging information, and reliability data. The electrical specifications help you make design decisions.

California Eastern Laboratories, 3260 Jay St, Santa Clara, CA 95054.

Circle No 753

Discussion of composite amplifiers

This 12-pg application note, *AN21: Composite Amplifiers*, discusses the compromises you must make in order to obtain optimal speed, drift, bias current, and noise and power output from an amplifier. It provides schematics and descriptions of composite amplifiers, which are suggested as alternatives to simple amplifiers. The note describes several applications, including a wideband FET input-stabilized buffer; a gain-trimmable wideband FET amplifier; a fast, stabilized noninverting amplifier; and a stabilized, ultra-wideband amplifier with a slew rate over 3000 V/μsec.

Linear Technology Corp, 1630 McCarthy Blvd, Milpitas, CA 95035.

Circle No 758



How to build programmable gain amplifiers

This 12-pg application note, *CMOS DACs and Op Amps Combine to Build Programmable Gain Amplifiers, Part II,* examines the performance of dual-CMOS DACs as gain-determining elements in a programmable-gain-amplifier (PGA) system. It discusses how you can achieve greater accuracy over a wide dynamic range, using a dual-DAC circuit. Some of the subjects in the note include basic equations for a dual-DAC PGA, comparing errors, small-signal bandwidth, and dynamic-gain errors. Equations, circuit diagrams, and tables illustrate the text.

Analog Devices, Literature Center, 70 Shawmut Rd, Canton, MA 02021.

Circle No 754

Memory data reference

The fourth revision of the Memory Data Manual DL113 presents specifications for the vendor's MOS static RAMs, dynamic RAMs, and PROMs, CMOS and MECL (current mode logic) memory technology, and information about devices that meet military standards. Its 12 chapters deal with support for system-level designs. The manual includes pin assignments, packaging options, a list of basic features, electrical features, operating condi-

tions, and timing-diagram specifications. $1.35 (25).

Motorola Inc, Technical Information Center, Box 52073, Phoenix, AZ 85072.

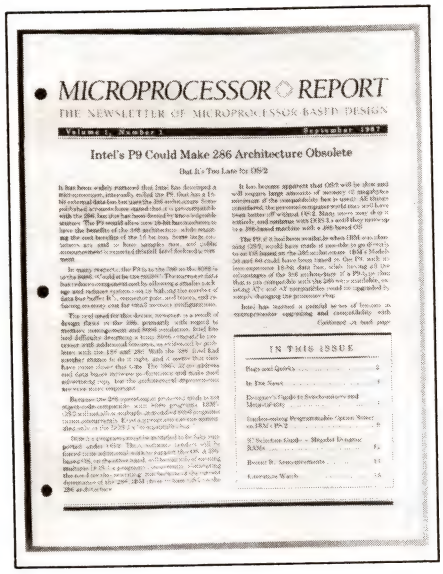
INQUIRE DIRECT

Product directory lists semicustom ICs

This 24-pg product directory encompasses semicustom and radiation-hardened ICs, as well as MIL-STD-1553 and MIL-STD-1750 products. It describes each product, lists specifications, and includes block diagrams. Inside the cover pages, the catalog provides an overview of the company and a list of sales representatives.

UTMC, Communications Dept, 1575 Garden of the Gods Rd, Colorado Springs, CO 80907.

Circle No 755



Newsletter for microprocessor designers

Written exclusively by design engineers, the monthly newsletter *Microprocessor Report* addresses the needs and concerns of designers of μP-based hardware. It focuses on design techniques, product evaluation, and development tools. It includes product descriptions, analysis, circuit examples, and bug reports. A monthly index of the most significant articles in journals and trade magazines, as well as design techniques for IBM's Micro Channel and Apple's Nubus, are regular features. The subscription rate is $195/year.

MicroDesign Resources Inc, 230 California Ave, Palo Alto, CA 94306.

INQUIRE DIRECT

App note features V/F converters

The application note, *AN14: Designs for High Performance Voltage-to-Frequency Converters,* investigates circuit considerations that arise when designing V/F converters. It also examines the advantages and drawbacks of various approaches to V/F conversion and contains complete schematics for the converters.

Linear Technology Corp, 1630 McCarthy Blvd, Milpitas, CA 95035.

Circle No 757

Choosing op amps and data-conversion products

The 8-pg *Product Selection Guide* features more than 80 operational amplifiers and data-conversion products. It provides information about single, dual, and quad op amps; and low-offset-voltage, low-power, low-bias-current, low-noise, high-slew-rate, and wideband amplifiers. In order to facilitate your selection of converter products, the guide lists specifications for 8-, 10-, and 12-bit resolution ADCs and DACs.

Precision Monolithics Inc, Box 58020, Santa Clara, CA 95052.

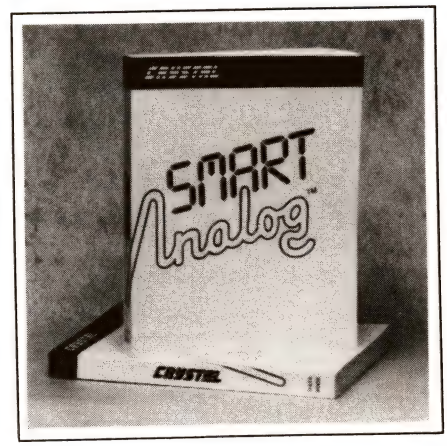
Circle No 760

Linear/digital ASICs characterized

The 182-pg Exar/Exel Military Databook presents product specifications for military-compliant linear/digital ASICs and high-performance electrically erasable devices. It describes fabrication processes and procedures that are used to meet MIL-STD-883C. The fabrication descriptions appear in the sections on product assurance, documentation military screening and qualification and quality conformance inspection. The product data sheets include device features, performance characteristics materials, drawings, and schematics. Special sections deal with custom and semicustom linear, digital, and linear/digital ICs.

Exel Microelectronics Inc, Box 49007, San Jose, CA 95161.

Circle No 761

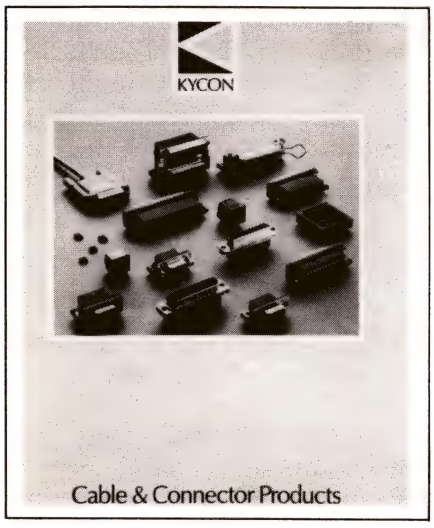


High-performance ICs cataloged

The 544-pg data book *Smart Analog* describes the vendor's full line of analog ICs. It provides an overview of products and operations, including price and performance benefits, as well as data sheets for 11 new products. The publication divides the semiconductors into categories of ISDN line interfaces, T1 and PCM-30 telecommunications-line interfaces, jitter attenuators, DTMF receivers, statically and dynamically tested ADCs, and track-and-hold amplifiers and filters. Besides providing overall product information, the catalog discusses quality, reliability, and mechanical data, and lists sales representatives throughout the world.

Crystal Semiconductor Corp, Box 17847, Austin, TX 78760.

Circle No 759



Booklet spotlights cables and connectors

This 40-pg illustrated catalog presents the vendor's cable and connector offerings. It describes D-subminiature connectors, miniature ribbon connectors, modular jack connectors, PLCCs (plastic leaded chip carriers), minishunts and microshunts, miniDIN connectors, and custom cables. The booklet features dimensional drawings, tables, and specification lists. Among the specifications provided are ratings for voltage, contact current, contact resistance, dielectric withstanding voltage, insulation resistance, and temperature. An index and blank pages for writing engineering notes complete the publication.

Kycon Cable & Connector Inc, 1887 O'Toole Avenue, C103, San Jose, CA 95131.

Circle No 785

Guide for backplane designers and engineers

The *Backplane Interconnect Systems Design Guide* assists you in specifying connector requirements, insulator height, throat depth, grid spacing, number of pins, contact plating, tail length, solid or press-fit pins, and daughter-board lead-ins. The 49-pg guide includes information about repair kits, contact replacement tools, and telephone plugs. It features 2-D and 3-D drawings; ratings for current, insulation resistance, and dielectric withstanding voltages; and plating specifications for nickel, gold, and tin. The guide comes in a 3-ring binder.

Stanford Applied Engineering, 3520 De La Cruz Blvd, Santa Clara, CA 95050.

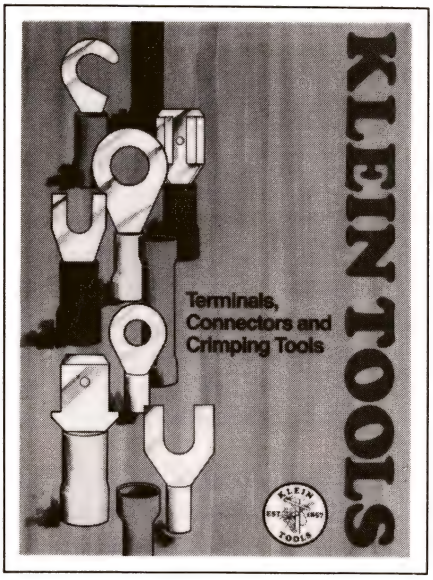
Circle No 787

Booklet features card-edge connectors

The 36-pg catalog, *Card Edge Connectors,* focuses on the vendor's card-edge-connector series that comes on 0.05- to 0.336-in. contact centers with wire-wrap, dip-solder, solder-eye, and right-angle terminations. The descriptions of the 56-connector series incorporate specifications, dimensional drawings, and photographs.

Methode Electronics Inc, Connector Div, 7447 W Wilson Ave, Chicago, IL 60656.

Circle No 790



Reference for terminals, connectors, crimping tools

This 16-page illustrated catalog spotlights the vendor's line of crimping tools, and insulated bellmouth and noninsulated terminals and connectors. The illustrations show the actual size and shape of each model in the quick reference charts. Also included are color-coded wire-range sizes, stud sizes, hole diameters, and product dimensions. Further, the publication provides information about connector and tool kits, and the vendor's line of combination wire-stripping, cutting, and crimping tools.

Klein Tools Inc, 720 McCormick Blvd, Chicago, IL 60645.

Circle No 786

Publication lists terminal strips

This 56-pg catalog (No 3000) focuses on single-row, double-row, and closed-side-barrier terminal strips. It discusses the advantages of the different kinds of strips and provides specifications for each device. The book, which is perforated with punched holes for placement in a binder, features dimensional drawings and a guide to UL ratings.

Vernitron Corp, Beau Products Div, Box 10, Laconia, NH 03247.

Circle No 788

Enclosure design kit offered

The Engineers Electronic Enclosure Design Kit provides a broad overview of the vendor's enclosure line. It includes corner samples of the vendor's Heavy Duty and Challenger frames, a copy of its 304-pg catalog, enclosure order and quote forms, an EMI/RFI technical guide, a galvanic compatibility chart, shielding test results, and a price list.

Equipto Electronics Corp, 351 Woodlawn Ave, Aurora, IL 60506.

Circle No 793

Book presents multitude of handles

The 84-pg catalog, *Handles Unlimited,* examines the vendor's handles for electronic equipment and for furniture. It describes round, half-round, oval, rectangular, offset, slanted, folding, and bar handles

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CIRCLE NO 224

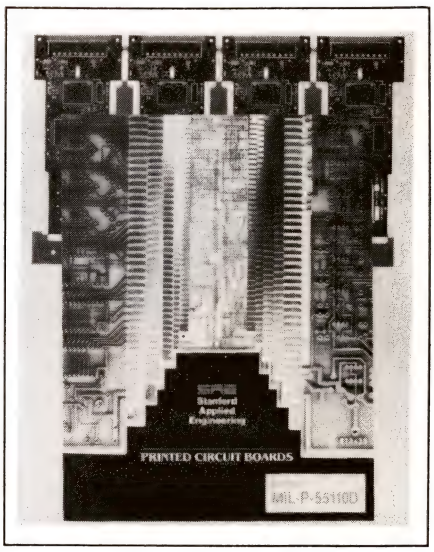
made of aluminum, brass, or stainless steel and featuring either internal or external threads. The publication provides tables of specifications for each device and includes photographs and dimensional drawings.

Vemaline Products, Div of Square Head Inc, 333 Strawberry Field Rd, Warwick, RI 02887.

Circle No 791

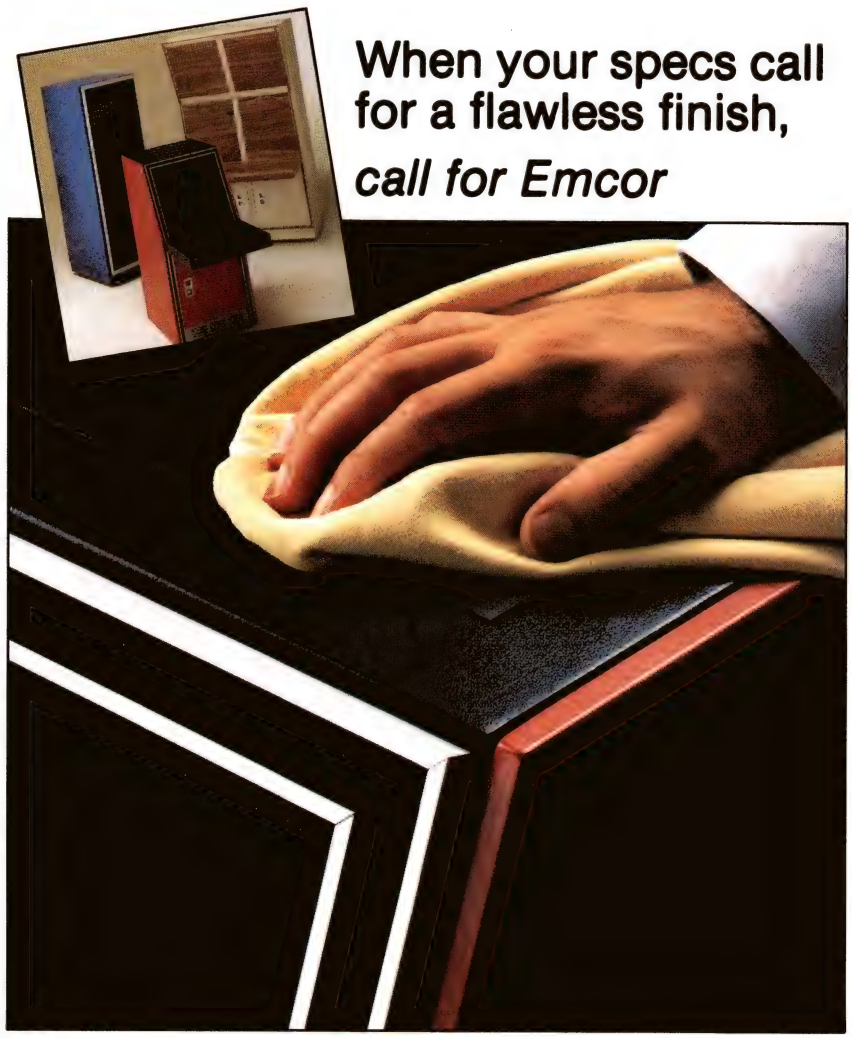
Pamphlet discusses pc-board design

This 4-pg publication presents the vendor's pc-board design, manufacturing, and quality-control capabilities. The brochure examines such topics as tape programming, precision hole drilling, fabrication, etching, cleaning, through-hole plating, and multilayer design and manufacturing processes.



Stanford Applied Engineering, 3520 De La Cruz Blvd, Santa Clara, CA 95050.

Circle No 792



When your specs call for a flawless finish, *call for Emcor*

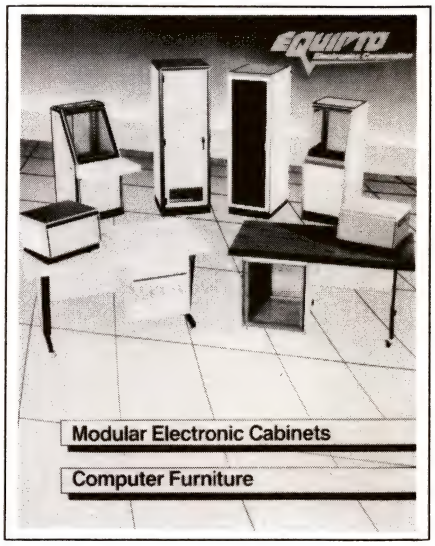
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Phone 507-289-3371
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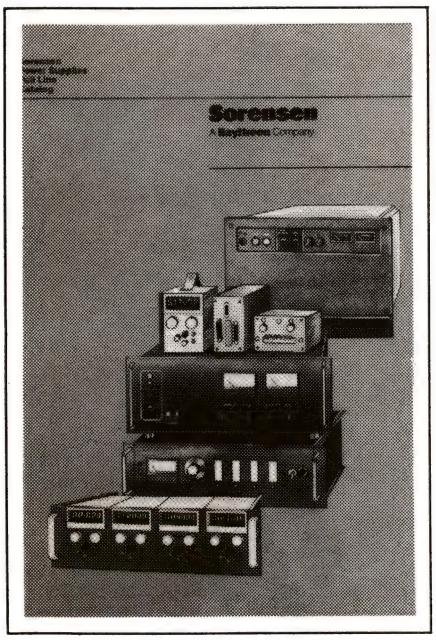


Modular cabinets categorized

The 1988 Modular Cabinet Catalog presents the vendor's line of modular racks, sloped-front consoles, desks, computer furniture, and instrument cabinets. The 304-pg publication outlines the dimensions of each unit and offers schematic drawings.

Equipto Electronics Corp, 351 Woodlawn Ave, Aurora, IL 60506.

Circle No 789



Catalog details a variety of power supplies

The vendor's catalog highlights a wide variety of power supplies. It lists IEEE or analog programmable devices from 60W to 20-kW linear-type supplies used in ATE and benchtop applications and 500W to 20-kW SCR regulator-type supplies used in high-power ATE and burn-in applications. The book also summarizes power supplies, having output from 20 to 1000W for OEM-type requirements in data communications, telecommunications, and other electronic-equipment applications.

Sorensen Co, 5555 N Elston Ave, Chicago, IL 60630.

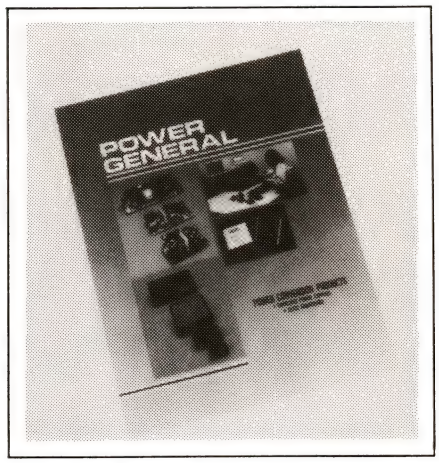
Circle No 768

DC/DC converter handbook

This 144-pg handbook presents the vendor's complete line of switching power supplies and dc/dc converters. Selection tables provide product descriptions and engineering data on all models. The catalog contains glossaries of power-supply terminology, information about power-supply theory of operation, and application notes.

Power General, Box 189, Canton, MA 02021.

Circle No 769



Power-supply catalog

This 7-pg short-form catalog outlines the company's range of power supplies, including rack-mounting, modular, switch-mode, stabilized, and unstabilized units. Supplies

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BERTAN Associates has specialized in the design and manufacture of precision high voltage power supplies for over two decades.
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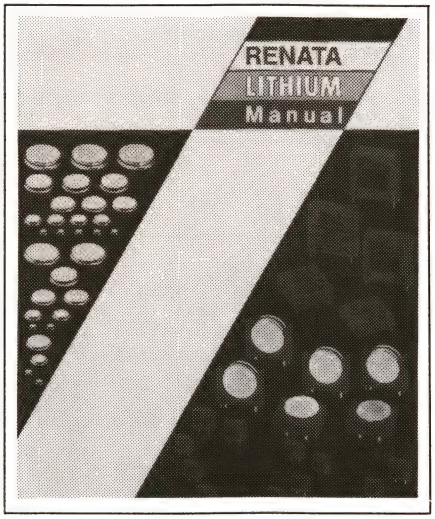
listed include low-, medium-, and high-voltage types; the catalog also provides information on the company's high-voltage test equipment and meters. It includes information on supplies suitable for driving photomultiplier tubes, ion-implantation equipment, avionics displays, military systems, and lasers. Details of the company's custom design service are also provided.

Bonar Wallis Hivolt, Dominion Way, Worthing BN14 8NW, UK.

Circle No 772

Booklet covers lithium products

This 28-pg manual deals with lithium batteries and power modules. Besides summarizing information about the vendor's complete line of products, the publication focuses on applications. It provides environmental, safety, and quality data and covers industry-standard button



cells for low-cost consumer and computer-memory backup applications. Applications discussed include process control, data acquisition, portable equipment, and factory automation.

International Power Sources Inc, 10 Cochituate St, Natick, MA 01760.

Circle No 770

Publication presents power sources

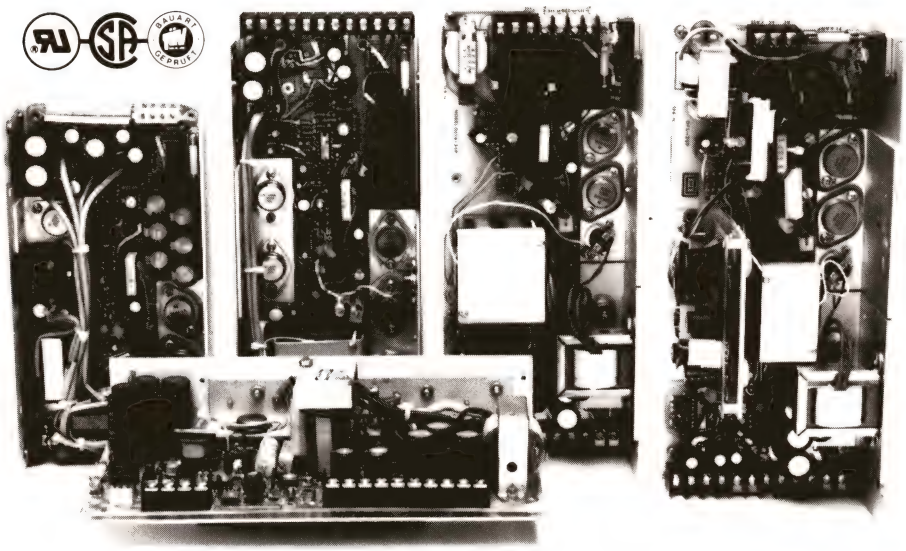
This 6-pg fold-out brochure discusses the Megahertz Power LM-200 Series dc/dc converter modules. The selection guide lists power modules with 24, 24/48, 48, 150, and 300V dc inputs and outputs of 5, 12,



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Free Literature

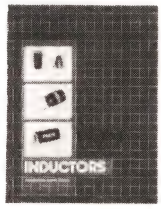
Low-Cost Magnetic Components Available from Stock



PC Power Transformers-
UL Recognized and CSA Certified.

Full line of PC Power Transformers. From 1.1 to 36 VA. Features 3-flange bobbins for complete isolation. Low profile models. Catalog includes parallel and series secondary performance ratings and mechanical specs. Includes cross references to Signal, Stancor, Microtran, Triad part numbers.

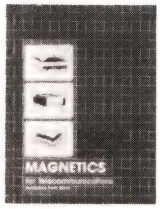
CIRCLE NO 229



Low Cost Inductors

Full line of PC Mountable Inductors with ferrite-core construction. Series includes economy high current inductors, ferrite power inductors with drum core, slug core and bobbin core construction, and wide band shield bead ferrite chokes. Physical and electrical specifications and available options included.

CIRCLE NO 240



Magnetics for Telecommunications

Stock components for virtually any interconnect requirement. Nearly 90 different coupling transformers for voice and data applications including feed-bridge inductors and single hybrid transformers. Many economy, low profile, BSI and Australian Telcom applications. Includes physical and performance specifications.

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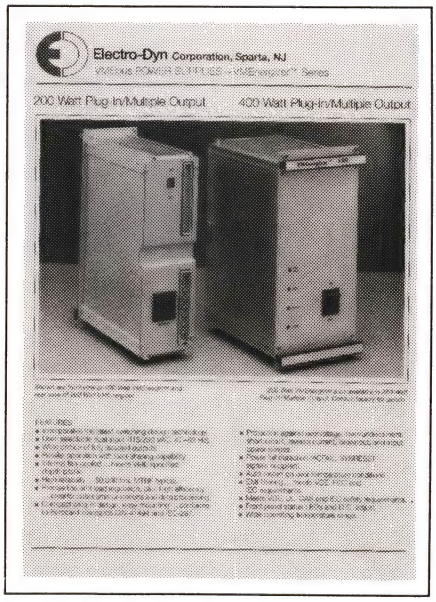
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LITERATURE

15, 24, and 48V dc. Six figures, two tables, and ordering information complete the brochure.

Lorain Products, 1122 F St, Lorain, OH 44052.

Circle No 767



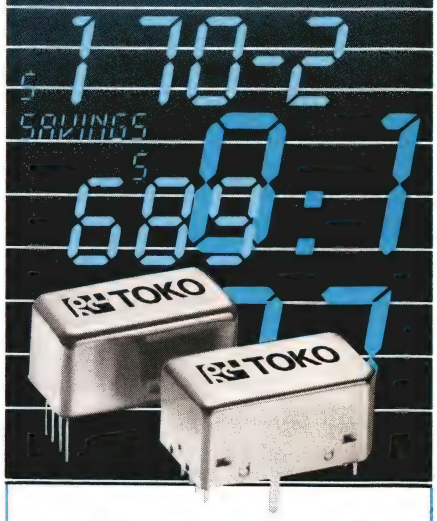
Brochure details VME power supplies

This 4-pg pamphlet outlines the specifications and features of the company's 200 and 400W VME plug-in/multiple-output power supplies. It also includes voltage/current selector charts, as well as outline and pin-connection drawings.

Electro-Dyn Corp, 90 Sparta Ave, Sparta, NJ 07871.

Circle No 771

Toko DC-DC Converters: A Bright Idea for Powering Vacuum Fluorescent Displays.



Whether you're using Futaba, ISE or NEC vacuum fluorescent displays, Toko CPS series DC to DC Converters are the power solution to provide grid, anode and filament voltages —with high reliability and cost savings. They also provide stable power for modems, RS-232 interfaces and other subsystems requiring mixed operating voltages, at prices much lower than other power alternatives. Contact us to be sure you're not over specifying your DC to DC Converter needs.

High performance characteristics:

- ☐ Stable output levels for flicker-free displays
- ☐ High switching frequency and ceramic substrate design combined with SMT for high power and very compact size
- ☐ Full metallic shielding and matched external filtering prevents EMI problems
- ☐ Delivers rated performance from -20 to +65°C at 10 to 85% RH

The CPS series is available in power outputs to 2.4 watts, with input voltages of 1.7 to 30 VDC and output voltages ±5 to ±50 VDC or 1 to 10 VRMS AC. For more details and application assistance, contact Toko America today.

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CIRCLE NO 230



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We've sold over 14 million switching power supplies in the past 10 years. More than any company. Anywhere. Not to mention largest market share. So says a recent industry study.*

Yet some people still draw a blank when they hear the name Astec.

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Your Standards Will Never be the Same.

The long list of Astec standard power supplies comes from proven OEM designs that have put us in our place atop the market.

Ranging from 30 to 1500 watts, our standards give you power to be your best. Without the costs and delays of designing your own.

And with our large local stock and quick distribution, most models are only hours away—thanks to our manufacturing capabilities that can turn out 4 million power supplies a year. Each undergoing tough computer testing and 100% burn-in to ensure over 200,000 hour MTBF.

Get a Taste of Foreign Customs.

When you need switching power supplies, Astec's overseas operation keeps costs down and quality up.

So all you supply is the need. And we'll supply the power. Exactly what you want.

Which won't be a problem, since our U.S. headquarters provides sales, engineering and service around the nation.

To learn more about The Real Power or to locate the distributor nearest you, call Astec now: 800-7AS-TEC7, ext. 11. Or write: Astec USA, 2880 San Tomas Expressway, Santa Clara, CA 95051; (408) 748-1200.

We look good on paper. And better in your designs.

*Study done by Venture Development Corporation.

ASTEC

The Real Power

CIRCLE NO 231

Catalog highlights diverse software

This software catalog describes 49 scientific, engineering, and business programs for the IBM PC, PC/XT, PC/AT, and compatibles, as well as programs for handheld calculators and interactive videotape/software training. It also features Estipipe, a piping man-hour estimating program; MathTool, a tool box of numerical analysis techniques; and InstruCalc 2.1, a recent version of the instrument engineering calculation program. Further additions include the ChemCalc, PetroCalc, and PipeCalc series.

Gulf Publishing Co, Software Div, Dept G9, Box 2608, Houston, TX 77252.

Circle No 775

Programming language manual

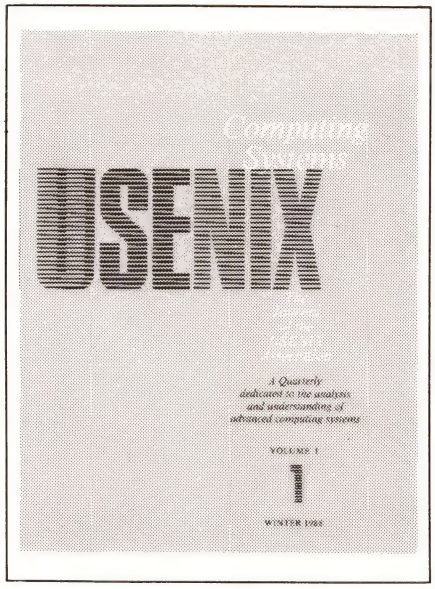
The *Occam 2 Reference Manual* serves as a reference text for the high-level Occam programming language or as an introduction to the language for anyone who has a reasonable understanding of programming languages. The 132-pg paperback volume examines the language from its most elementary processes to actual procedures and functions. The manual is designed for computer scientists, software engineers and programmers, electronics engineers, and system designers.

Inmos Corp, Box 16000, Colorado Springs, CO 80935.

Circle No 776

Quarterly review emphasizes Unix tradition

Based on systems influenced by Unix, *Computing Systems*, a quarterly journal of the Usenix Association, concentrates on the analysis and understanding of the theory, design, art, engineering, and implementation of advanced computer systems. Specifically, it deals with operating systems, architecture, networking, programming, languages, and advanced applications. Nonmember US subscription, $40; single copy, $10.



Computing Systems, University of California Press, 2120 Berkeley Way, Berkeley, CA 94720.

INQUIRE DIRECT

Public-domain software listing available

The 1988 *Catalog of Public Domain PC Software (Shareware and User Supported Software)* lists user-supported software, several drafting programs, and a 3-D CAD program capable of animation. The main body of programs covers 14 topics, including statistical process control, project management, surveying, and flow charts. Copying fee, $3/disk (10).

Sector Systems Co Inc, 416 Ocean Ave, Marblehead, MA 01945.

INQUIRE DIRECT

Catalog on software developed with NASA aid

The 1988 Cosmic catalog describes 1219 computer software programs, as well as 59 newly added programs, that have been developed with the aid of NASA funding. The abstract for each program explains the program's capabilities, provides information to help you decide on applications, and lists the programming language, machine environment, size, and prices of the source code and supporting documentation. The publication also features keyword and author indexes, and subject classifications. Some of the program subjects include thermodynamics, structural mechanics, artificial intelligence, image-processing heat transfer, and circuit design. Printed edition, $25; microfiche set, $10; magnetic tape, $50.

Cosmic, The University of Georgia, 382 E Broad St, Athens, GA 30602.

INQUIRE DIRECT

Software development courses offered

This brochure describes available language, operating-system, and software-engineering courses. It covers new courses in advanced C programming, including software requirements and specifications, software quality assurance and testing, and software maintenance, and a hands-on workshop. The publication discusses the subjects and applications covered, hands-on activities, benefits, materials provided, authors and instructors, and locations.

Integrated Computer Systems, Box 3614, Culver City, CA 90231.

Circle No 777

The human side of programming

In the 20-pg booklet *Experts' Views on the Human Interface Traits of Successful Commercial Software,* programmers discuss the importance of interaction with users during program development, as well as the need to provide accessible software. Rather than developing an impersonal flow chart, they emphasize that programmers should consider users' personalities, demands, and work styles. The document includes interviews with each programmer in a question-and-answer format. Finally, the reference sec-

tion gives brief descriptions of books, publications, and organizations devoted to the human side of software development.

Solution Systems, 541 Main St, South Weymouth, MA 02190.

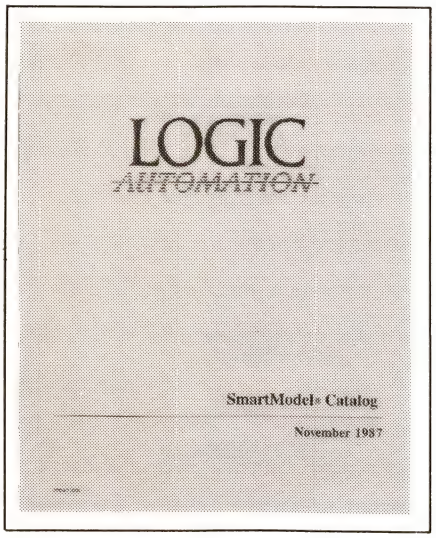
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How to select the right plotting software

The booklet *Versatec Graphics Software—the complete software plotting solution* helps you choose the right software for your particular needs. It covers four types of software: Versaplot, Versaplot Random, Versaplot Random Enhanced, and a variety of plotting utility packages. The publication differentiates between each type of software and contains a listing of all available packages.

Versatec, 2710 Walsh Ave, Santa Clara, CA 95051.

Circle No 778



Software catalog available with videotape

The vendor's SmartModel catalog lists the latest models for system simulation. A complete listing of distributors and representatives appears on the back cover. To help you evaluate the use of simulation for design verification, a videotape that provides a simulation of the design for an 80386 PC mother board is available.

Logic Automation, Box 310, Beaverton, OR 97075.

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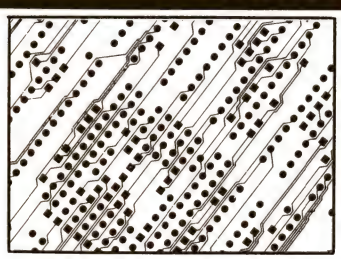
Software package presented

This 2-pg data sheet focuses on the functions of the Com 2 software driver that provides control of the vendor's logic programmers. It features sections on autorecall of preset parameters, color-enhanced displays, the main menu's device program sequence, and error statistics. It also explains the system requirements and provides a list of devices that the vendor's logic-programmer family supports. Color illustrations and a diagram of the package complete the publication.

Stag Microsystems Inc, 1600 Wyatt Dr, Santa Clara, CA 95054.

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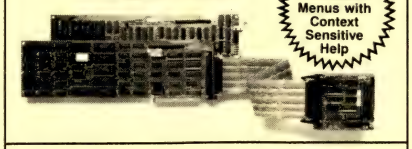
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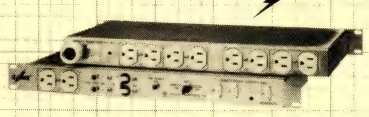


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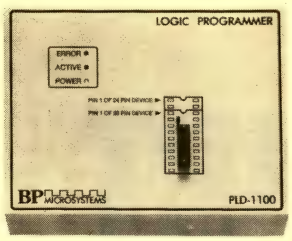
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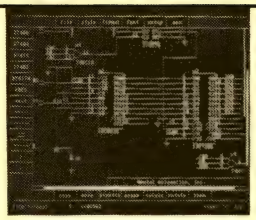


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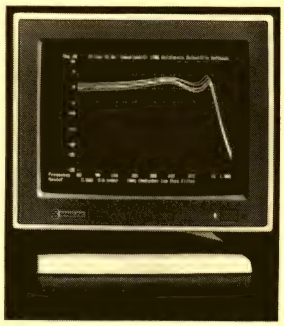
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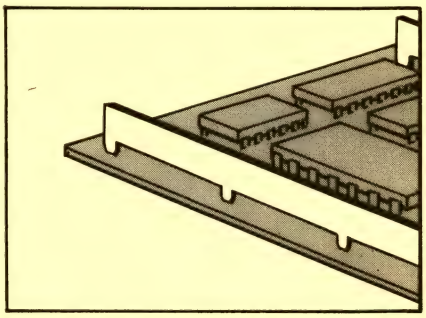
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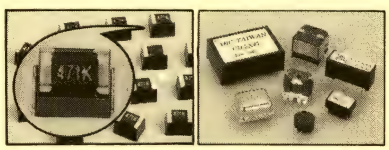


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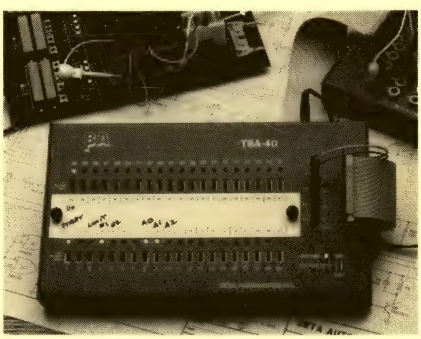


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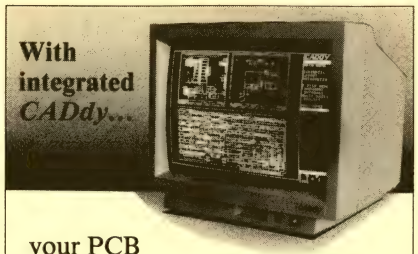
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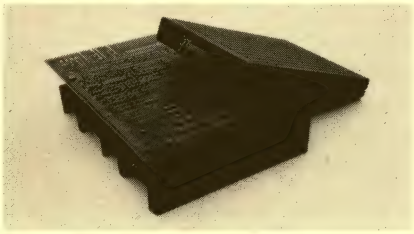
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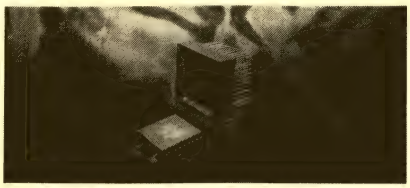
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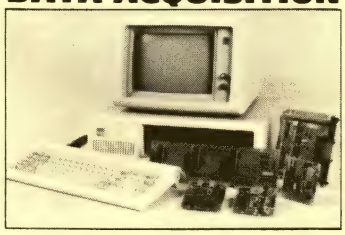
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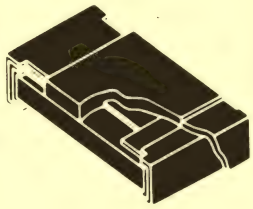
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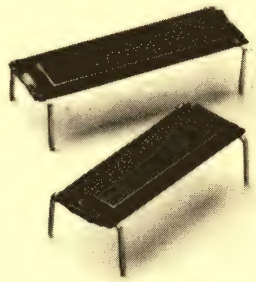
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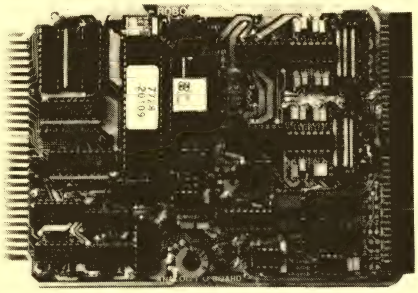


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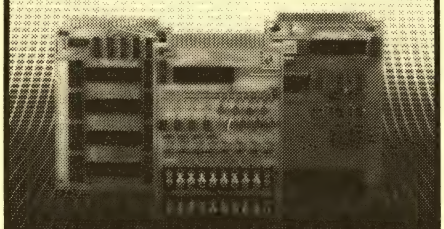


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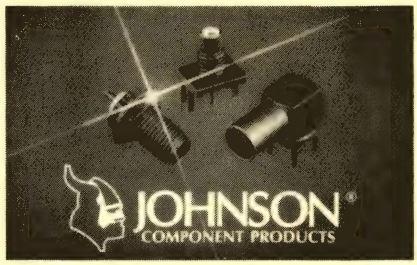
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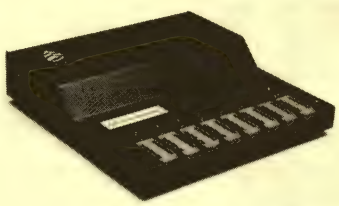
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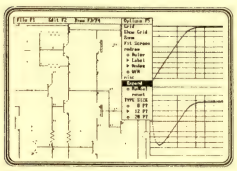
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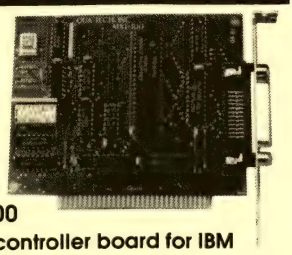
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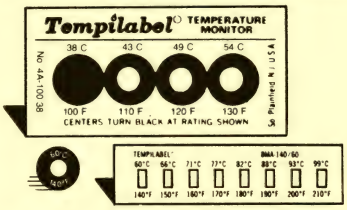
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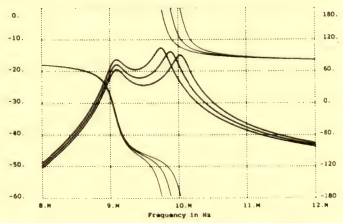


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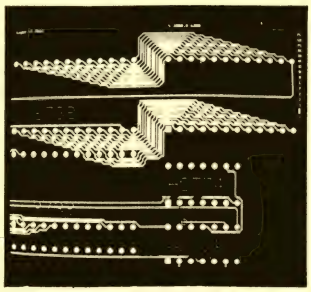
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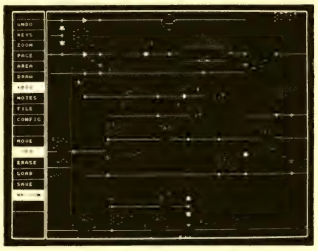
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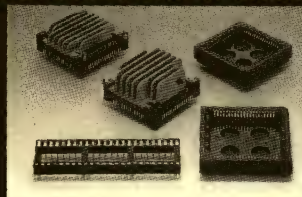
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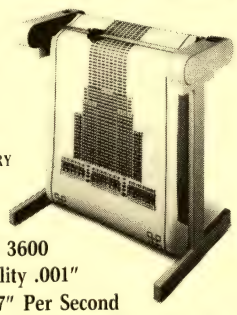
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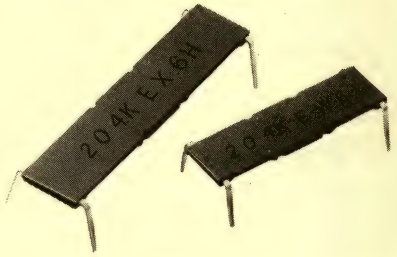
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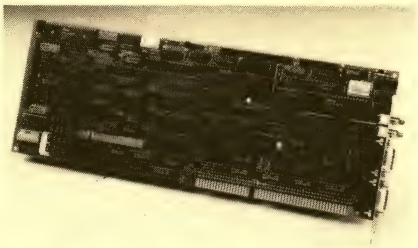


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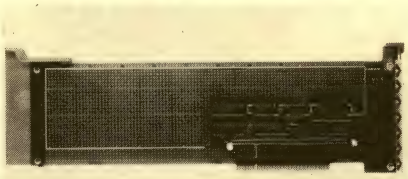
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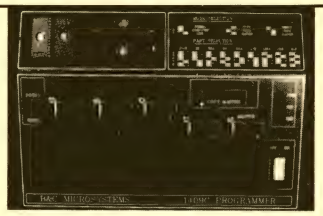


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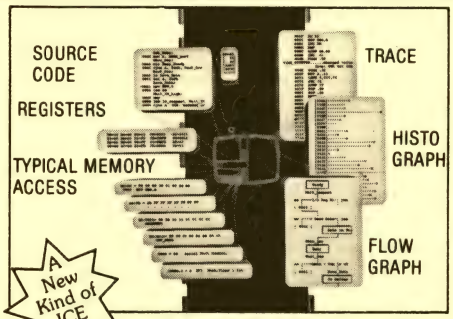
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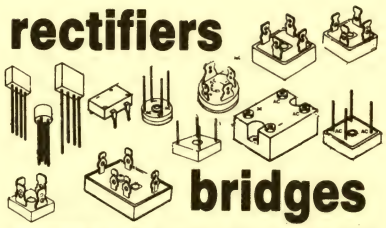
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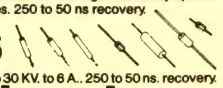
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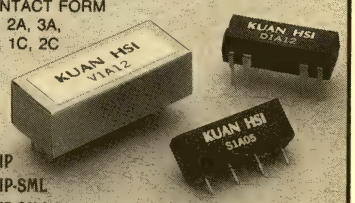
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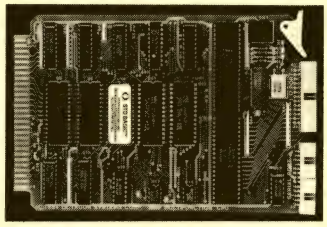
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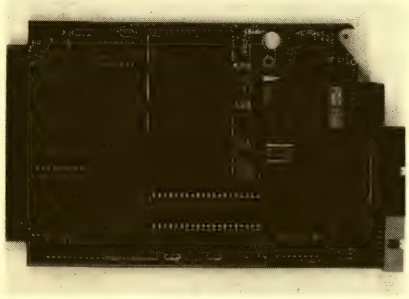
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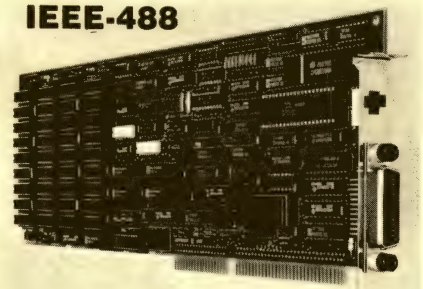
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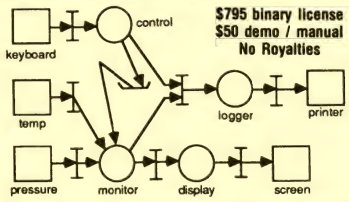
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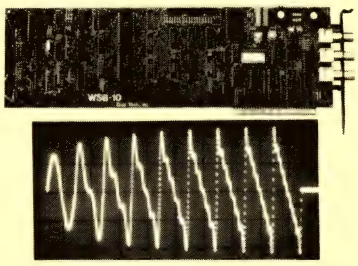


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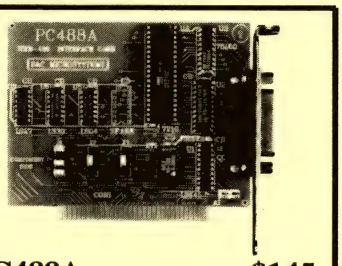


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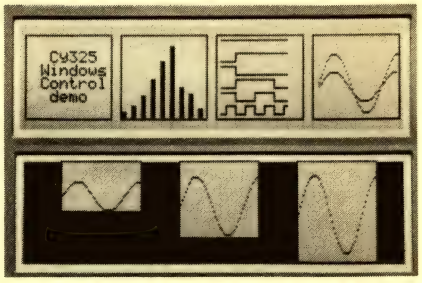
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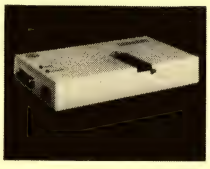
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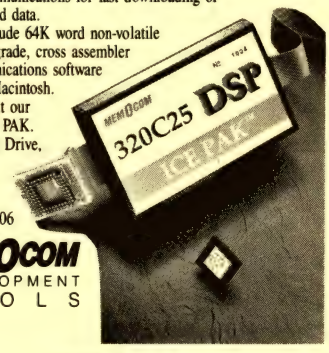
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Aug. 18	July 28	Military Electronics Special Issue, Displays, Military ICs	
Sept. 1	Aug. 11	Instruments, Op Amps, Computers & Peripherals	Closing: Sept. 1 Mailing: Sept. 22
Sept. 15	Aug. 25	Data Acquisition, Data Communications, Digital ICs	
Sept. 29	Sept. 8	DSP, Graphics, Optoelectronics	
Oct. 13	Sept. 22	Test & Measurement Special Issue, Instruments, Computers & Peripherals	Closing: Sept. 29 Mailing: Oct. 20
Oct. 27	Oct. 6	CAE, Computers & Peripherals, Integrated Circuits, Wescon '88 Show Preview	
Nov. 10	Oct. 20	Programmable Logic Devices, Integrated Circuits, Test & Measurements, Wescon '88 Show Issue	Closing: Oct. 27 Mailing: Nov. 17
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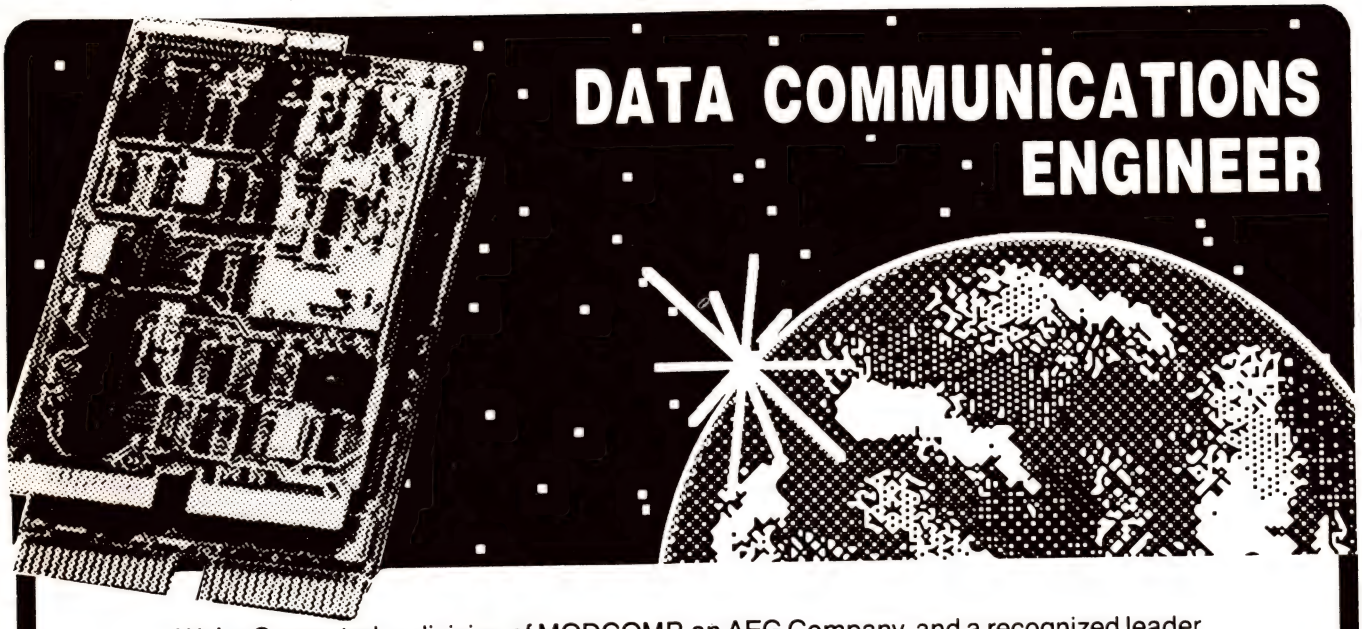
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We hope you're happy in your current position. At the same time, chances are there is an ideal job you'd prefer if you knew about it.

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Name _____
Home Address: _____
City _____ State: _____ Zip: _____
Home Phone (include area code): _____

PRESENT OR MOST RECENT EMPLOYER

Parent Company _____
Your division or subsidiary: _____
Location (City, State) _____
Business Phone if O.K. to use: _____

EDUCATION

Degrees (List)	Major Field	GPA	Year Degree Earned	College or University

POSITION DESIRED

_____

EXPERIENCE

Present or Most Recent Position From: To: Title:

Duties and Accomplishments: Industry of Current Employer:

_____

_____

_____

_____

Reason for Change:

_____

PREVIOUS POSITION:

Job Title: _____
Employer: _____ From: _____ To: _____ City: _____ State: _____
Division: _____ Type of Industry: _____ Salary: _____
Duties and Accomplishments: _____

COMPENSATION/PERSONAL INFORMATION

Years Experience	Base Salary	Commission	Bonus	Total Compensation	Asking Compensation	Min. Compensation

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Level of Security Clearance ☐ U.S. Citizen ☐ Non-U.S. Citizen My identity may be released to: ☐ Any employer ☐ All but present employer

☐ WILL RELOCATE ☐ WILL NOT RELOCATE ☐ OTHER _____

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Will be responsible for software project technical leadership, conformance to design/development and methods, design and implementation of software. The position will conduct and schedule appropriate design reviews/code walk throughs and assist in performance evaluations. Good written and verbal communications and leadership skills, also technical skills in design and implementation using assembly and "C" and skills and experience with systems software.

Requires BSCS or equivalent with 6-10 years design and implementation experience. Experience with scheduling and project leadership, systems software and 286 Protected mode programming. Project leadership, device driver and OS/2 Assembly programming is preferred. Code-2653.

"C" Programmer

Develops programs for automated test equipment. Work in a team environment with engineers to identify needs and develop solutions. BSCS or equivalent plus 2-5 years experience in test or disk drive environment. Code-2684.

Software Design Engineer

This position requires BSCS or BSEE and 3-5 years experience in product development or equivalent. MSCS or MSEE and knowledge of IBM architecture (PC, AT, PS/2), 8088 assembler and "C" experience is preferred. DOS device driver, OS/2 and multitasking system experience is also preferred. Code -2622.

Servo Development

Will be responsible for evaluating and developing state-of-the-art servo technology for advanced high performance flexible disk drives. Will model, evaluate and recommend technologies and design concepts in the mechanical, analog (electrical), and digital areas.

Requires: Systems and control theory background. BS in Electrical or Mechanical Engineering. Preferred: 2-3 years Winchester experience. Experience with firmware for control of electromechanical systems.

Analog Design Engineer

You will be responsible for the design and evaluation of circuitry associated with advanced techniques in the magnetic digital recording, optimizing analog circuitry for use in state-of-the-art removable disk drive products.

To qualify, you should possess a BSEE with a minimum of 4 years experience designing analog circuits. Experience in the design of read channel and phase locked read clock circuits is preferred. Code-2307.

Digital Hardware Engineer

Requires BSCS/BSEE or equivalent with 3-8 years of Microprocessor hardware and assembly language software design experience.

Familiarity with 8088/8086/80286 family, MS-DOS, and device driver design. Preferred: BSEE/MSCS with 5-10 years of experience with"C" language. Experience in a development environment in leading projects and managing people desirable for some positions. Code-2663.

Quality Engineer

Interface with vendors and IOMEGA engineers to analyze data, recommend and implement solutions. Excellent analytical communications and personal skills required. BS degree or equivalent plus 5 years manufacturing or process experience. Code-2428.

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Conducts head disk interface experiments to optimize recording head contour parameters and to support HDI engineering activity on released products.

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LOOKING AHEAD

EDITED BY CYNTHIA B RETTIG

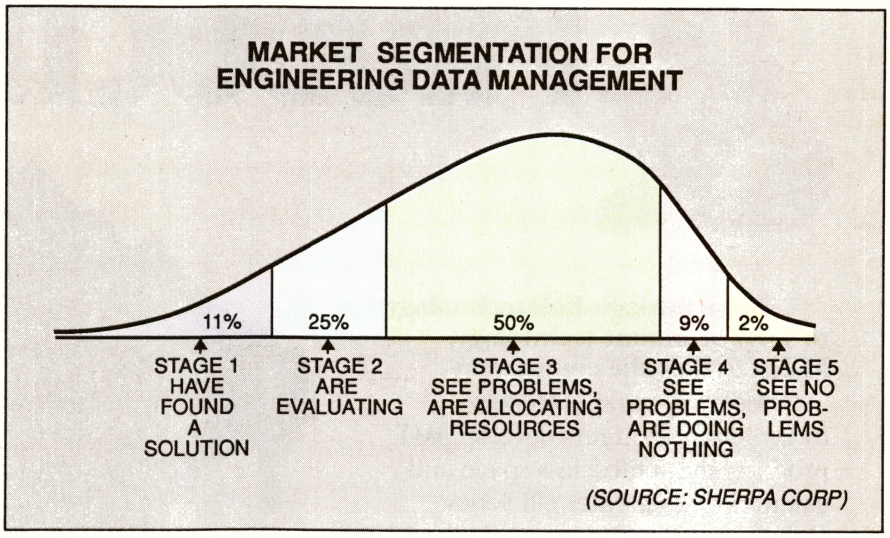
CAE bottleneck challenges project managers

Your CAD/CAE project is two weeks overdue at manufacturing, and you've spent the whole day trying to get last-minute changes into the final drawings. A number of people have signed off on the design, but it's not clear whether Bob saw the drawing before or after Ted made his changes yesterday. What's more, you've got to send the actual drawings to a site 600 miles away by morning, and you can't find one set of specification plans.

The solution to this dilemma (and many others like it) might be EDM —engineering data management. Large-scale CAE equipment and the automated projects it makes possible have created the need for EDM, which is comprehensive, centralized management of designs from the drawing board to the manufacturing stage. According to a survey recently commissioned by Sherpa Corp (San Jose, CA) and undertaken by Market Reach Inc (Mountain View, CA), engineers and managers involved in large CAE projects have lost the controls they had when they did their work on paper, and they generally have no substitute controls in place for designs that are produced primarily with electronic equipment.

Sherpa initiated the survey as part of its study of the marketability of software packages for engineering data management. Market Reach canvassed 266 engineers and engineering managers, who (by and large) worked for companies that manufacture defense, aerospace, and consumer electronics products. A surprising 97% of the respondents knew what EDM was. In fact, 51% already had a task force at work within their companies to study their EDM needs.

The respondents identified the top 10 critical problems that they believe EDM could solve. The primary problem is ensuring that the correct version of the data is always the one available. Other important issues involve managing engineers' changes, controlling the drawings, and protecting and controlling the data. Engineering data management can solve these problems by centralizing the data, making only the desired version of a design available, and making that version available only to authorized personnel.



The biggest bottleneck for most engineers occurs in the process of getting the design data into manufacturing. Essentially, what has happened is that major portions of the design phase have been taken over by electronic equipment. A large part of the manufacturing process—including materials-requirement planning, just-in-time strategies, and computer-aided manufacturing—has also been streamlined. The automated-design and automated-manufacturing processes are now applying pressure from both sides to the people reponsible for getting a design into manufacturing. Slow transfer of data to manufacturing, manual transportation of drawings, specification-release times, sign-off problems, and keeping track of changes can all bog down the intermediate process.

Approximately 25% of those surveyed said they had evaluated their needs and were ready to look at specific packages and make a purchase; 50% stated that they had EDM problems and were starting to study them. Another 11% had already purchased EDM software.

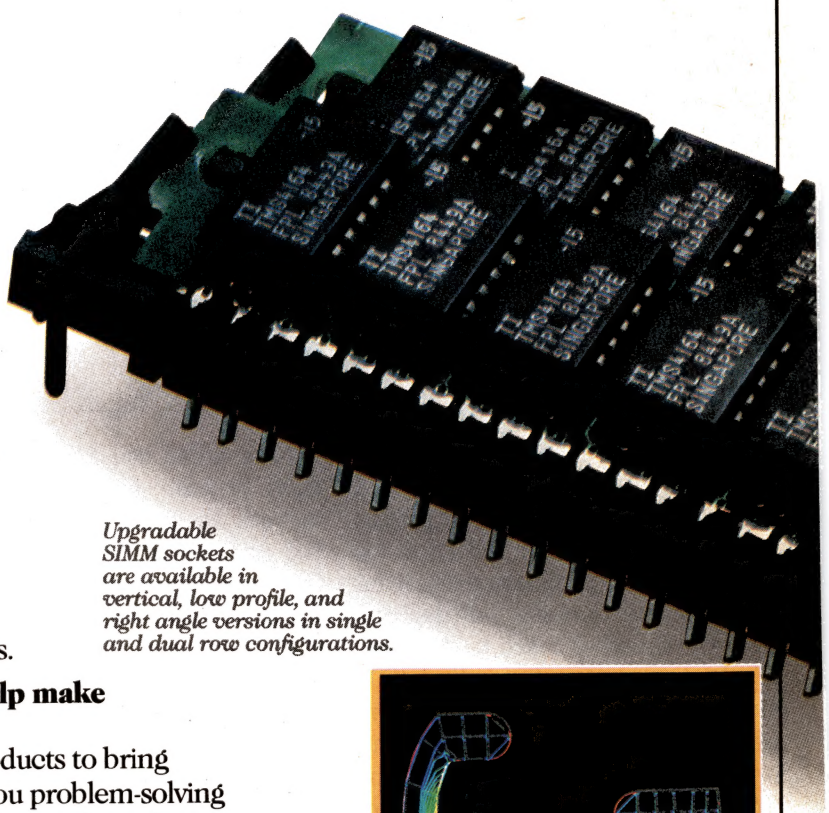
EDM software is not inexpensive. Of those respondents whose companies had already bought packages, 30% had invested more than two years and $1 million in their EDM software. Another 41% had spent more than one year and $500,000 on the project.

The EDM budget commitments for companies that had not bought any software were also hefty. Of that group, 22% expected to spend more than $500,000 on EDM, and 39% expected to spend between $100,000 and $500,000.

Market Reach Inc predicts that during the next two years, the potential market for EDM software—that is, the money already allocated for EDM solutions—will total about $700 million. Over the next five to 10 years, the market should grow out of its infancy and reach annual sales levels of between $500 million and $1 billion.

Making the Connection Between...

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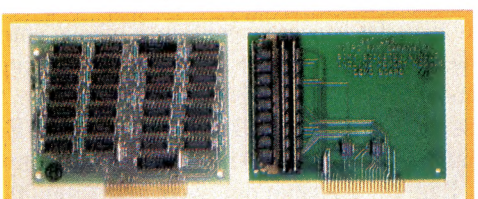
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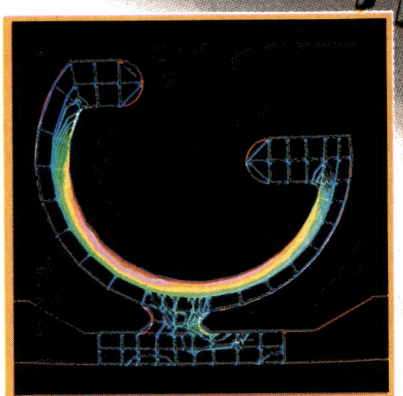
Molex is working to help today's manufacturers develop SMT products that utilize less space and assemble with greater efficiency. Components such as our SIMM sockets are currently helping major manufacturers utilize innovative SIP technology to achieve denser circuit board packaging and increased RAM capacity. And, systems such as our automated robotic PCB assembly equipment are speeding production time and reducing labor costs.

We take a systems approach to help make your bottom line more productive.

Molex goes beyond quality SMT products to bring you problem-solving systems for greater productivity. Molex helps you put new technology to work in real world manufacturing situations. From design and development to manufacturing and delivery, you can depend on Molex for interconnection technology that gives you a competitive edge.



Molex SIMM socket (right) takes up dramatically less board space than DIP packaging (left).



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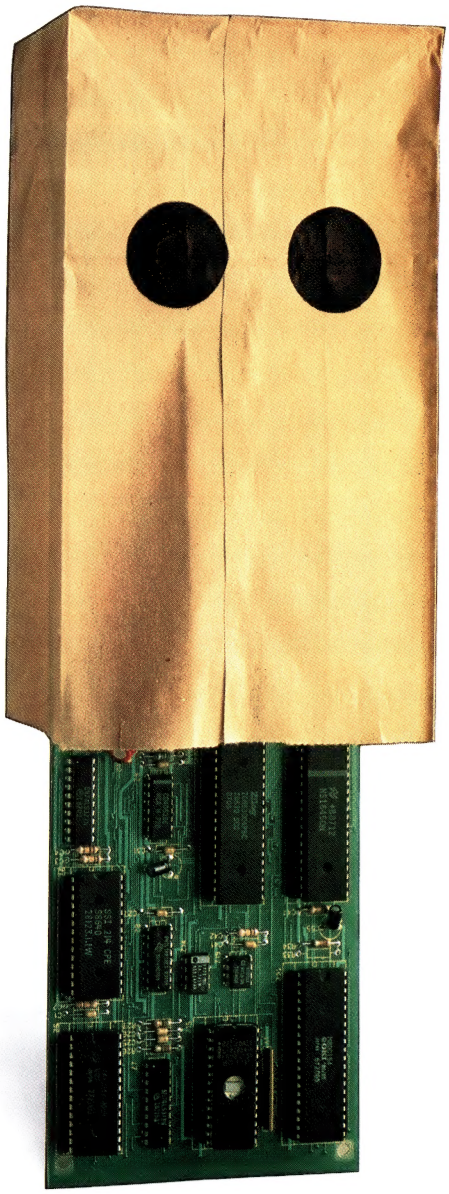
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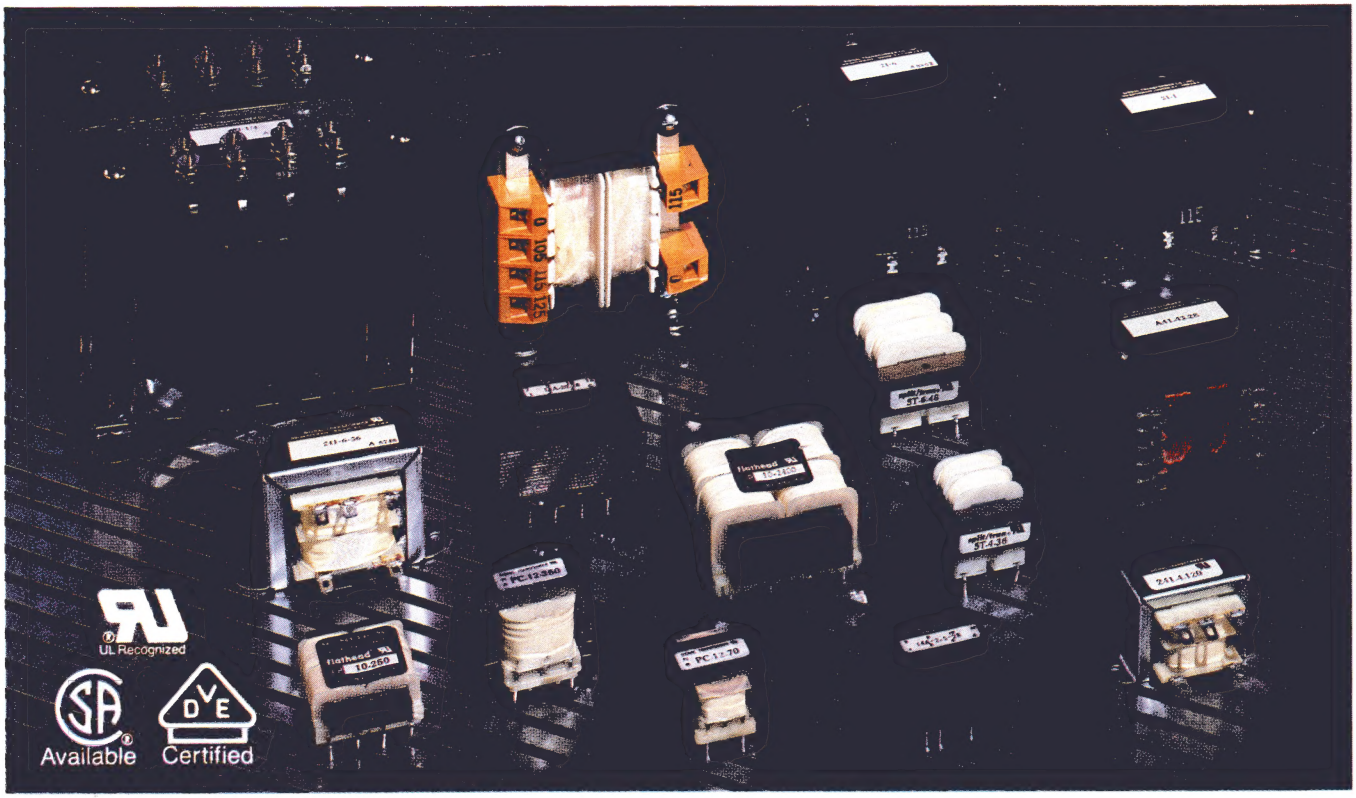
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